SWISS FINTECH
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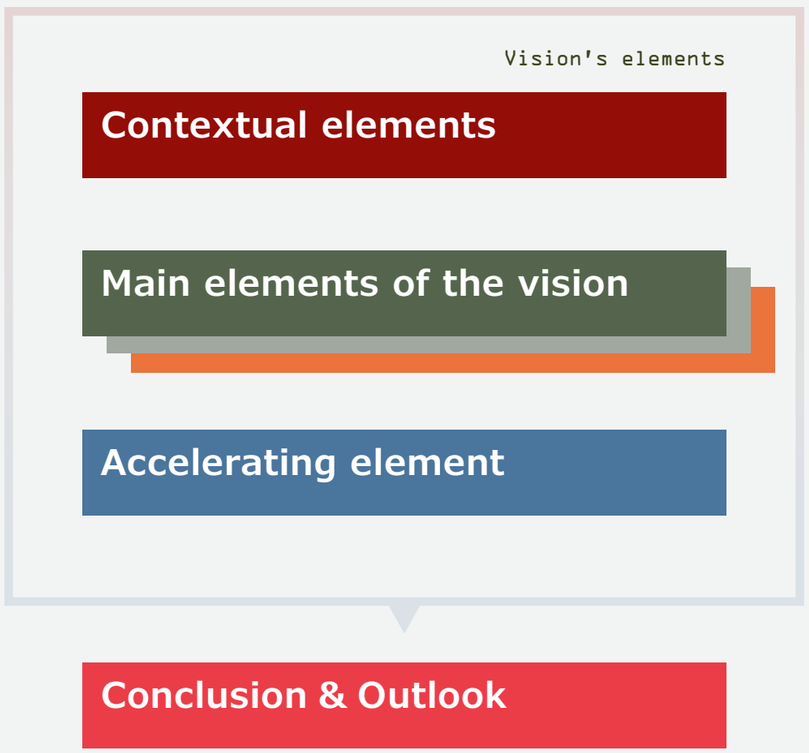
VISION OF TOKENIZED FINANCE

SFTI

Vision of Tokenized Finance

Outline of the report



The vision of Tokenized Finance is structured in three main parts:

1. In the *Outline of the report* the motivation, goals, scope and approach of the vision are defined. The chapter includes a newly developed *map of tokenized finance* as well as an introduction of the respective *ecosystem*. The map introduces the elements of the vision, and guides through the report at hand.

2. Subsequently, the elements of the vision are being introduced:

   - Firstly, as prerequisites the most important three contextual elements of the ecosystem are explained: regulation, KYC & digital identity, cyber & token security.
   - The main part of the report contains explanations of the six main elements of the Vision of Tokenized Finance. These six elements show several interrelations but are still self-contained and were developed by respective subject matter experts of members of SFTI.
   - Lastly, the project identified an accelerating factor, which will play an essential role to propel the identified elements into practice: interoperability.

3. The last chapter combines all elements and presents a coherent vision as a conclusion and suggests a way forward to close the gaps.

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Executive summary

The vision of tokenized finance is a forward looking vision for the coming 10 years in the space of Digital Assets in Switzerland. Tokenization has been identified as one of the biggest trends in the financial services industry. Hence, tokenized finance is a fast-growing industry that leverages blockchain technology to create a more open and accessible financial system. The SFTI paper on the vision for tokenized finance in Switzerland is describing how to create a financial system that is more inclusive, transparent and efficient than the traditional financial system (TradFi) we are currently experiencing.
Tokenized finance aims to create a new infrastructure for the FS industry, platforms and applications that allow for the creation and exchange of products based on digital assets (i.e. tokenized shares, stablecoins, CBDCs, staked crypto currencies, non-fungible tokens). This allows for faster and cheaper transactions, greater transparency, and more accessibility for people who are currently underserved by the traditional financial system.

The potential benefits of tokenized finance are numerous, including:

1. *Increased transparency:* Blockchain technology allows for greater transparency in financial transactions, reducing the potential for fraud and corruption.

2. *Increased efficiency:* Tokenized finance can automate many financial processes, reducing the need for manual intervention and increasing efficiency.

3. *Lower transaction costs:* By making use of a simplified infrastructure based on the blockchain technology, tokenized finance can reduce transaction costs and make financial transactions more affordable for everyone.

4. *Greater financial inclusion:* Tokenized finance has the potential to provide financial services to people who are currently underserved by the traditional financial system.

The vision of tokenized finance in Switzerland is similar to the worldwide vision of tokenization, as Switzerland is one of the leading countries in the development and adoption of blockchain technology and decentralised finance. However, Switzerland has a unique perspective on tokenized finance due to its status as a global financial hub and its reputation for financial stability and security. The Swiss vision for tokenized finance emphasises the importance of regulatory compliance and risk management, while still promoting innovation and growth in the industry.

In the past couple of years, Switzerland has taken important steps to establish itself as a global leader in tokenized finance, including the creation of the Crypto Valley and the establishment of a regulatory framework for blockchain and cryptocurrency businesses. This regulatory framework, known as the “Blockchain Act”, provides legal clarity and certainty for blockchain-based businesses operating in Switzerland, while still ensuring that they adhere to strict anti-money laundering (AML) and know-your-customer (KYC) requirements.

The vision of tokenized finance follows a new framework including the main elements of a tokenization (custody, issuance, trading, payments, lending and staking) as well as contextual prerequisites (Regulation, KYC / Digital Identity, Cyber & Token Security). All elements are introduced and analysed regarding how the group envisages them to develop over the upcoming 10 years. As one of the main overarching conclusions the group notes the importance of continuing to work on interoperability measures. Reaching the envisaged stage of tokenized finance is only possible by allowing interactions between different technologies, parties, processes, jurisdictions and standards. Thus the report finishes by highlighting some of the most urgent areas for the market and academia to concentrate on. These are:

- *Interoperability between Financial Platforms and Digital Assets Ecosystems*
- *Payment leg*
- *KYC and E-ID*
- *Secondary markets*
- *Disintermediation awareness*
- *Automation*
- *Education*

Overall the working group’s vision sets an ambitious roadmap for the market to follow. The dynamics of markets (i.e. company defaults[1], new products[2]) and regulatory changes might affect the analysed elements greatly. Thus, the working group might adjust the vision over time.

[1] Matt Levine, How not to play the game, Bloomberg

[2] Paul Katzeff, BlackRock’s Bitcoin ETF: What you need to know, Forbes

Why vision of Tokenized Finance?

Decentralised finance describes applications (e.g. decentralised exchanges or lending applications) that are solely built in the decentralised / distributed space and are based on the blockchain technology. This means that there are no intermediaries involved in such applications. The whole application is programmed by means of smart contracts and is fully automated without human or institutional intervention.

Tokenized finance on the other hand might use intermediary functions or parties at some interaction points in the ecosystem. The basic assumption however is that the assets themselves are issued and kept on decentralised or distributed ledgers. The world of Tokenized Finance might interact with DeFi and possibly over time migrate towards DeFi. However, we envision that Traditional Finance (TradFi) develops towards a mix between Centralised Finance and DeFi mostly because in a pure DeFi world the governance and regulations aspects are difficult to apply, control and comply with ([3]).

This differentiation also shows one of the main aspects of the vision at hand. While there can be various roles for centralised services in a world of tokenized finance, the assets themselves should always be issued, managed and kept on a decentralised ledger. Otherwise, all potential benefits of the decentralised ledger technology (DLT) will eventually not be operationalised.

[3] Summary of the public consultation for a Swiss E-ID (in German), p.5, (11/2021): “Unbestritten ist die in den Motionen geforderte Ausstellung der E-ID durch den Staat.”

Outline of the report

Since the publication of the white-paper “Bitcoin: A peer-to-peer Electronic Cash System” in 2008 the topic of decentralised ledger technology (DLT) became one of the most discussed innovation topics in the financial services industry. The alternative to the old financial system based on mainframe systems is clearly one of the most advanced fields of application for DLT. The guarantee of efficiency, transparency, liquidity and inclusion are the main underlying reasons for DLT. Evidently, there have not only been boom phases, but also various market corrections. Simultaneously, regulatory aspects have evolved as well and are continuing to be adjusted. Thus, it appears that the following years will be crucial to the future development of DLT in finance and potentially to the world of finance in a broader sense.
The term tokenized finance follows a clear intention. Tokenization describes the process of transforming traditional assets (e.g. ‘fiat’) into digital assets by using distributed ledger technology. These digital assets (in the form of IT-processed tokens) lay the foundation for all financial applications ranging - or even go further - from payment to lending and asset management. Thus, the groundwork for reaching more transparency and efficient processes and more liquid markets consists of providing tokenized assets on a broad scale. The term tokenized finance also underlines the intention of bridging the remaining gap between the traditional financial markets and the digital asset developments.

Motivation

Swiss Fintech Innovations Association (SFTI) connects some of the most prominent and driving forces of the Swiss financial services industry. With the objective of driving collaboration and digital innovation SFTI is committed to contribute to innovations of the Swiss financial system based on DLT. This also clearly builds on and complements the previous SFTI projects “Tokenization of Digital Assets” and “Future of Finance”.

In light of recent financial turmoil in the markets of traditional and digital assets, it is a great point in time for an industry-led situation analysis and a prospect of how to go forward regarding DLT. SFTI therefore took the initiative by commissioning the vision at hand. It shall provide guidance to achieve an ambitious but realistic integration of DLT into financial markets in approximately ten years’ time. The vision also includes the gaps that need to be addressed to reach the envisaged state and its related goals and benefits.

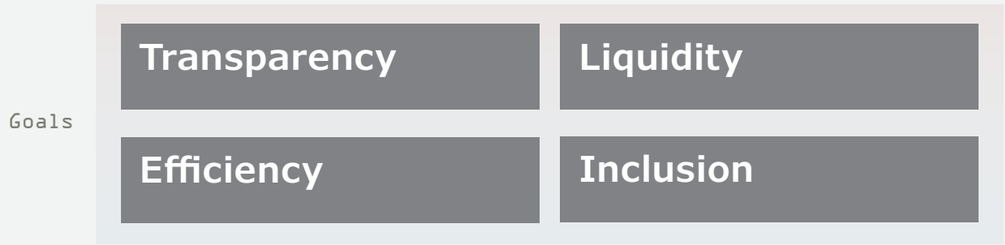


Figure 1 – Benefits of Tokenized Finance

Goals of tokenized finance

The underlying objectives of almost all DLT related projects can be attributed to the following four goals:

Reaching a more *transparent* system to transfer and manage assets could be seen as the underlying goal of all tokenization. Peer-to-peer systems in general can only function with a certain degree of transparency. This does not mean that e.g. personal data shall or will be stored transparently. The goal is to allow a quicker and easier way of validation and reconciliation of transactions. Eventually, it helps to minimise risks. Transparency also helps issuers e.g. by enabling easier interactions with their investors.

Anyhow, transparency could be seen as the underlying requirement for the other two goals: efficiency and liquidity. As current transaction systems heavily rely on intermediaries streamlining the respective processes, reducing or eliminating the need for intermediaries naturally increases *efficiency*. More and more activities related to the underlying assets could be digitised as well (e.g. dividend payments could be paid out automatically to each token holder).

Thirdly, one of the most important factors, which is important for any kind of asset, is its *liquidity*. Liquid assets are more attractive to investors than illiquid assets. However, tokenization in and of itself does not provide liquidity. Tokenized assets may be more easily tradable, but they do not necessarily need to be liquid. Nevertheless, the aspect of tradability could be seen as one of the main contributing factors.

Last but not least, a tokenized world of finance will not only benefit the current stakeholders. The core principle of decentralisation and all the aforementioned other three goals provide the chance to level the playing field and therefore to allow more people *access to financial services*, due to the technological enabling through blockchain. Where services might have been too expensive, efficiency gains will lower the costs. Where missing exit options may have hampered investors to invest, an improved tradeability might increase investor attention. And, where people did not have access to most financial services at all, applications such as lending and staking in the tokenized world might enhance the opportunities for both businesses and investors.

However, financial *inclusion* is not only one of the goals of tokenized finance. Somehow, it is also the driver for it. According to Clayton M. Christensen, disruptive innovations happen at the bottom of the market by being less expensive (in this case due to transparency and efficiency) or more accessible (in this case due to the aspects of decentralisation and the global outreach of the technology) and then continuously improving the mechanisms while eventually surpassing the incumbent processes and market players. Though it is too early to predict such a development with full confidence, there certainly are some indicative signs, which point to the *disruptive potential* of a world of tokenized finance.

Digital vs. crypto assets

The differentiation between the terms crypto and digital assets is not consistent across different definitions of both terms. Most often they are used interchangeably. Sometimes the term crypto assets is used as a subcategory of digital assets. While a clear distinction is not necessary for this report it is nevertheless noteworthy that both crypto and digital assets are actively applying cryptographic technologies. This fact points towards the more important fact about crypto / digital assets: both are usually based on distributed ledger technologies such as blockchain technology. Thus, while assets generally could have been digital before the time of DLT, to qualify as digital assets in this report they necessarily need to be recorded in and managed by a distributed, decentralised system. The most popular exception might be CBDCs.

Tokenized assets

The more important term for this report is tokenization or tokenized assets. The term tokenization clearly points out the process of transforming traditional assets into tokenized assets, which are based on DLT. Thus, tokenized assets are mostly the same as crypto or digital assets but the term is more precise and leaves less room for interpretation. Furthermore, tokenized assets can refer to both fungible and non-fungible tokens. Lastly, the term tokenized assets mostly refers to non-native tokens (i.e. tokens that are being issued using an existing blockchain protocol such as Ethereum). Native tokens (e.g. Ether) are not described as tokenized assets as they do not have a respective traditional or virtual asset as an underlying.

Scope & Approach

The vision's objective is to paint a realistic but ambitious picture of the future world of tokenized finance *in 10 year's time*. The project team's approach was to first define the main affected areas, services and processes for a world of tokenized finance. The following framework of tokenized finance is the outcome of these discussions. The visualisation leads through the report by structuring the whole topic into six main elements (Custody / Safekeeping, Issuance, Trading, Payments, Lending, Staking), three contextual prerequisites (Regulation, KYC / Digital Identity, Cyber & Token Security) and one accelerating factor (Interoperability). A coordinated development of these ten elements leads to the above defined goals (transparency, efficiency, liquidity, inclusion).

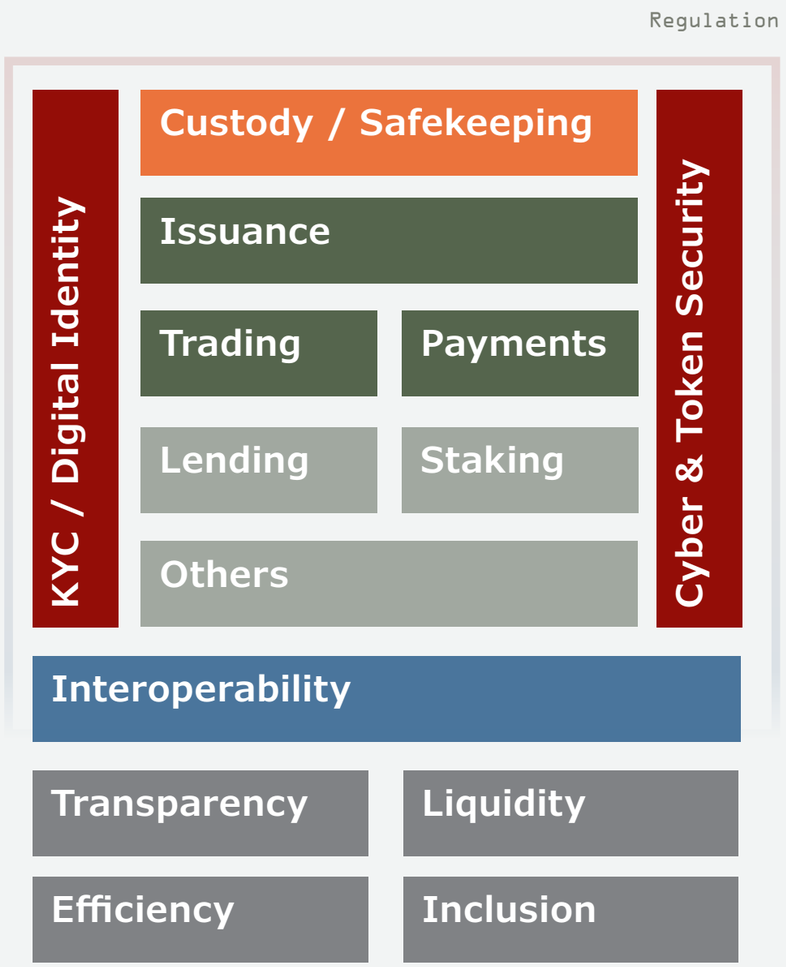


Figure 2 - Framework of Tokenized Finance Ecosystem

The inputs and contributions to these ten elements have been delivered, discussed and rendered by individual groups of subject matter experts of SFTI-members. They all follow a similar structure and show some interrelations. Nevertheless, they represent independently orchestrated parts of the vision of tokenized finance. The conclusion at the end of the report however is combining all aspects and shows a condensed view on the vision of tokenized finance. Furthermore, the vision also points out gaps between today's situation and the industry's potential and ambitions. Eventually, possible approaches to close these gaps are proposed.

Geographically the focus lies on Switzerland. However, the world of tokenized finance is often even more internationally intertwined than the traditional world of finance. Thus, the future development cannot stop at the border of Switzerland. International collaborations and a close exchange of information will be of great importance to uphold Switzerland's leading position.

Before dwelling on the above introduced elements in great detail, it is important to also highlight the stakeholders of the vision of tokenized finance. The following chapter highlights the most important players and points out their roles.

Introduction of the ecosystem

To fully embrace the vision in which tokenized assets can be exchanged, moved, and delegated in a flexible and integrated manner it requires not only individual organisations to harness the full capabilities of the vision, but also to actively seek out partnerships and cooperations so that constantly evolving non-functional requirements from customers are met. The parties of the ecosystem are not limited to commercial publicly traded or privately owned organisations, but for example also include state/government entities who will need to expand definitions of existing laws or develop new regulations to support a tokenized asset class in its various flavours (stock, physical asset, intangible capability such as voting rights), along with the new implications they bring on how public and private entities cooperate today. In the vision at hand SFTI focused on the following groups of stakeholders:

- *Financial corporations and FinTechs*
  Regulated parties such as banks, insurance companies and financial market infrastructures in general (exchanges, CSDs, settlement systems, etc.) are joined by FinTechs (which partly are already regulated). While some players only recently entered the space, the financial sector nevertheless is becoming increasingly active in developing solutions and applying DLT and digital asset related products and services.

- *Public institutions, politics, regulators*
  Obvious essential players such as FINMA and the SNB are at the core of many underlying discussions regarding tokenization. However, other parties such as foreign states (international interoperability and cross border issues) or the tax office(s) are to be involved in the further development of the market. Switzerland is generally providing a very progressive view on DLT applications. With the enacting of the DLT-law in 2021 the foundation has been laid to further develop the digital asset space.

- *Investors*
  At the core of the innovation around tokenization and digital assets are the investors. This group consists of individuals and institutional investors (e.g. pension funds, family offices, companies). Their needs and potential benefits of the digitalization aspects and user friendliness of tokenized assets should be at the core of the development.

- *Issuers*
  The issuers of digital assets play an equally important role as the investors. As seen in many other developments of the financial markets (e.g. the founding days of many exchanges), the start is often difficult. The famous chicken and egg problem is ever present. The tokenization ecosystem is currently facing a similar issue. Investors will enter the market as soon as more supply (tokenized assets) are available. Supply is provided by issuers who again only enter the market if sufficient demand (investors) is present. Therefore, the issuers play an equally important role in the whole development of the tokenization of financial products and services as the investors. However, the key here is education and regulation in the area of digital assets, since a deep understanding of digital assets by potential institutional or retail customers and a regulated environment around digital assets will lead to an increase in adoption.

- *Other facilitators*
  Last but not least, the ecosystem involves a broad variety of other parties. Most of them offer supporting activities or even the underlying technological foundation for the various activities related to applications of tokenization. The non-exhaustive list contains, for example, technology and infrastructure providers, consultants or auditors. Also academia plays an essential role regarding education and research in the DLT and tokenization sector.

Tokenization ecosystem

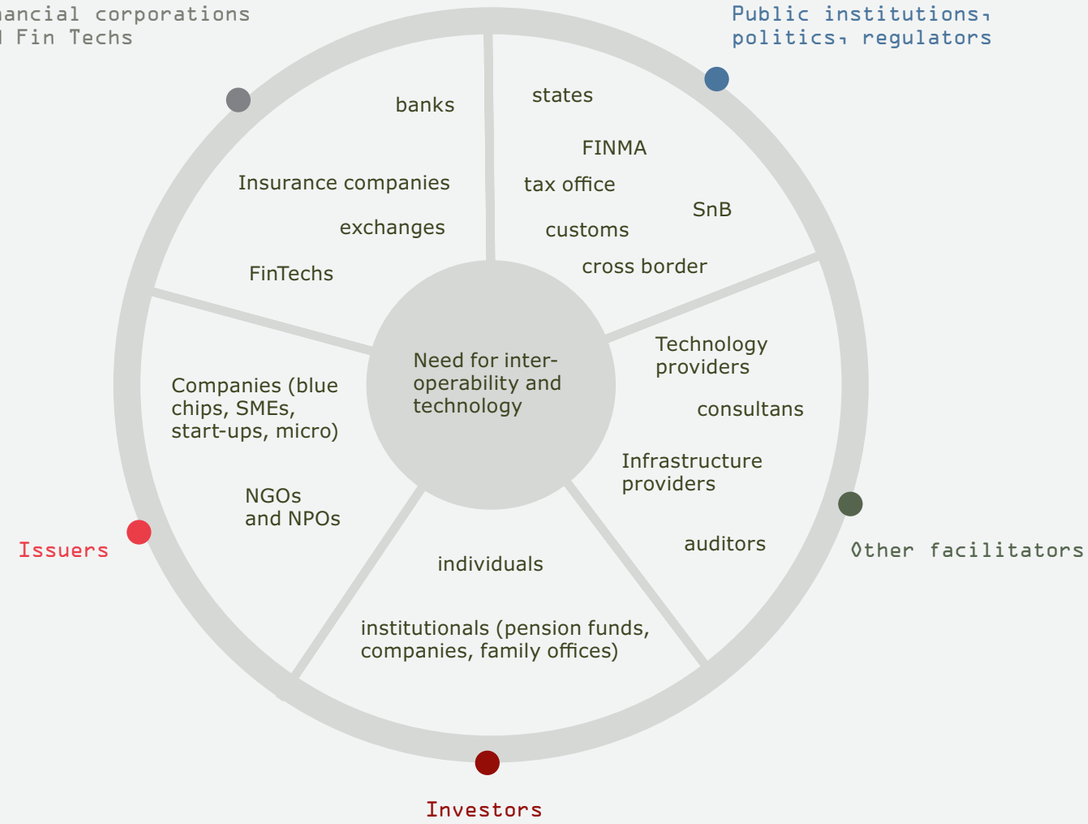


Figure 3 - Stakeholders of Tokenization Ecosystem

Contextual elements

The long-term development of tokenized finance, as presented in this report, is not self-sufficient and cannot be fully enabled without taking the important contextual elements as prerequisites into consideration. These elements are partly specific to the financial industry and provide a fundamental context when exploring the vision of tokenized finance. In this section, some key prerequisites in the areas of legal and regulatory context, compliance aspects, and safeguarding digital assets are discussed.

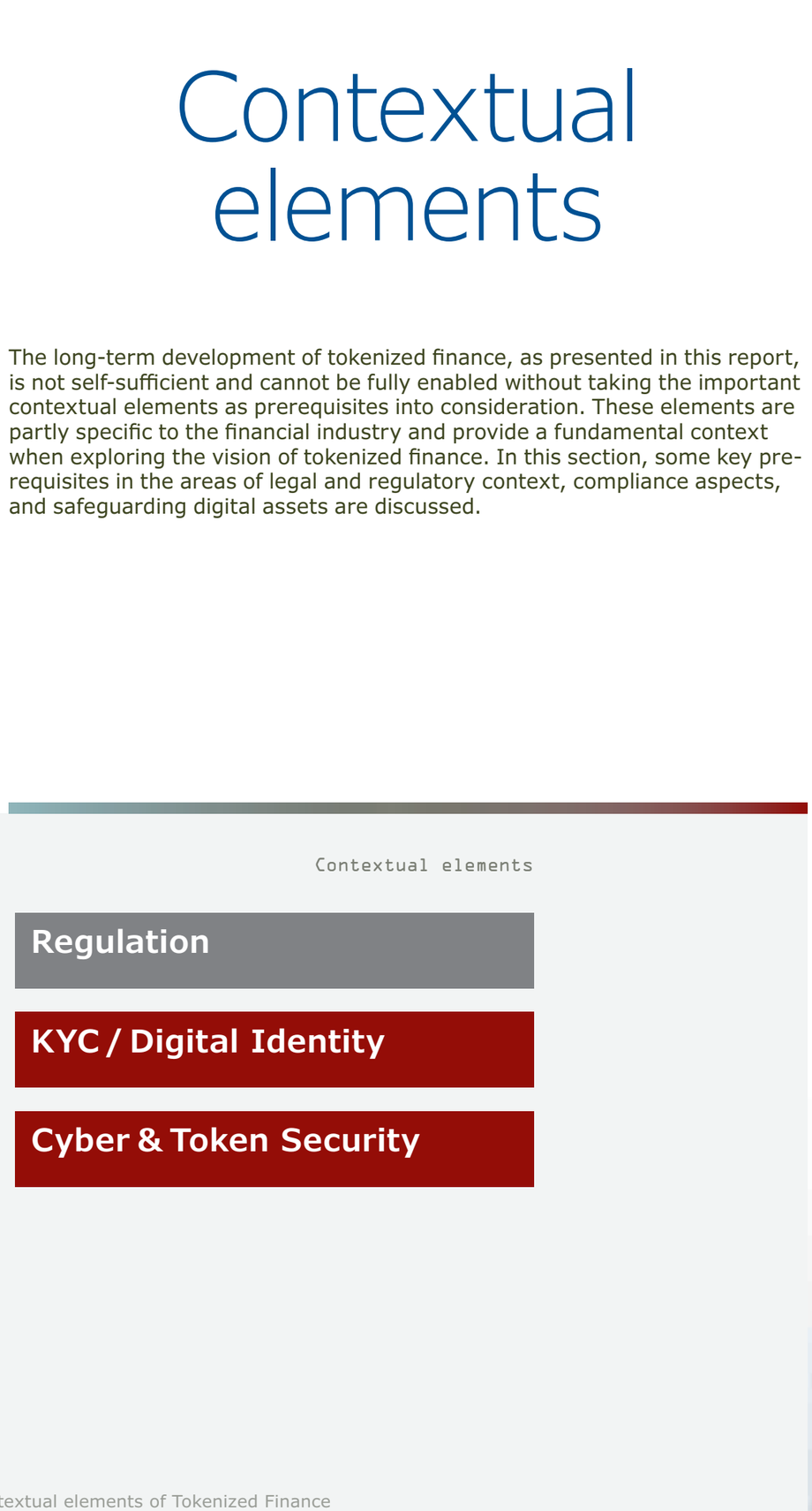


Figure 4 - Contextual elements of Tokenized Finance

Regulation

Regulations need to be designed and adapted to ensure that the risks associated with the topic at hand, such as those related to fraud, market manipulation, money laundering, and cybersecurity, are effectively mitigated. Robust regulatory frameworks are therefore essential to build trust in tokenized finance and such new ecosystems.

In this vision of tokenized finance, an environment where financial assets can be seamlessly tokenized and traded, we deliberately abstracted away from the regulatory constraints that exist in the current system. This does not mean we disregard the importance of regulations, but instead we tried to foster an unimpeded ideation process that is not immediately limited by current norms. Lastly, including regulatory aspects in the paper would have exceeded its scope.

Simultaneously, while this vision is inherently expansive and transformative, it is essential to understand that a world of tokenization cannot exist in a regulatory vacuum. As we turn this vision into reality, taking regulatory aspects into account will be of utmost importance. A well-regulated tokenized world of finance is key to ensuring that our vision benefits everyone and does not become a tool for exploitation.

It’s crucial to note that the regulations we need might not exist yet, or may need significant evolution. The technology and concepts we are dealing with are novel, and consequently, require innovative regulatory thinking. This means working hand in hand with regulators to draft policies that can safeguard interests without stifling innovation. Switzerland has proven in the past to be able to accommodate such a pragmatic and swift decision process where politics, regulators and the industry collaborate on developing new state-of-the-art mechanisms.

In conclusion, although our vision of a tokenized world of finance deliberately partly overlooks the regulatory considerations, it is not dismissive of them. As we start to explore the practicalities of implementing this vision, regulatory aspects will play an increasingly pivotal role. The next step in realising this vision is thus to engage in a dialogue about what a regulatory environment for a fully tokenized financial system might look like. This is an essential part of the process, ensuring that our tokenized world of finance is not just visionary, but sustainable, secure, and beneficial for all.

KYC and Digital Identity

Introduction

A streamlined client due diligence, identification and verification process (summarised here under the term “KYC”) should allow clients, both natural persons and legal entities, to easily onboard onto different venues. This lays the foundation to allow a simple transfer of tokenized digital assets without the need to repeat the due diligence procedures at every participating institution of the respective ecosystem. The availability of a government-verified digital identity is deemed a vital element to simplify identification and verification of participants and to avoid misuse of such an ecosystem.

Current Situation and faced challenges

In today’s environment, the processes of client due diligence, identification and verification are *largely “non-digital”* and typically repeated at every institution, lacking common standards and prohibit exchange between institutions:

- At client onboarding, every person and/or corporation needs to be onboarded separately at every institution. Clients need to provide client identifying data in a largely *non-standardized process* at every onboarding event, sometimes even *multiple times* for different purposes at the same institution.
- *These processes are being repeated* at different stages of the client lifecycle as well as during verification and re-certification activities, at *different frequencies*, and very often, *not being coordinated* across institutions or even within the same organisation.
- This process is *highly manual*, and, despite general digitization efforts across all industries, most of the information is still “*paper based*” which creates countless “*media breaks*” and leaves a lot of potential for further *automation*.
- Fraud cases are common where criminals use fake IDs or fake documents at the initial identification and verification processes.

Vision

We envision a solution and ecosystem where we see the following scenario and solutions:

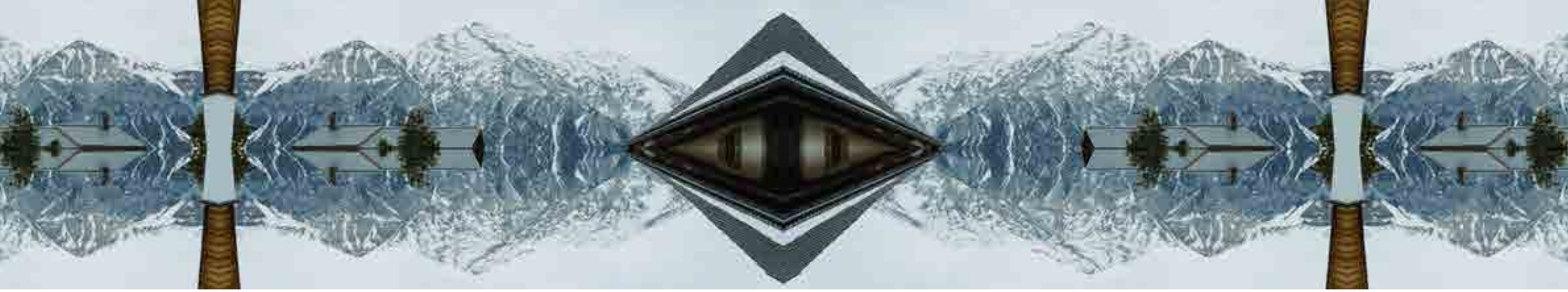
- *Clients* possess their own Self-Sovereign Identity (SSI) based on a recognised electronic identification (E-ID), which can be connected to a variety of distributed ledger technology (DLT) systems. This allows clients to take full control of their identification data in a tokenized format. Personal information can be added to the profile in a standardised way, allowing clients to decide which institution can access which information and for what purpose. This comes with ownership and responsibility for the client to maintain the data and keep it up to date.
- *Associated institutions* can access and retrieve client information based on their needs, prompting information requests and necessary updates.
- *Information* is securely and reliably linked to DLT systems in a manner compliant with the General Data Protection Regulation (GDPR), only being fully accessible by the owner of the data and temporarily by the associated institutions with which the data has been shared through a transparent process. Data is only shared for an agreed and pre-defined timeframe and/or specific purpose. Additionally, a log of every access is made, including the details of the data that has been accessed.

The above described solution and its driving ecosystem is *widely recognized* by *governmental authorities* (within and outside Switzerland), *regulators and regulatory bodies* (e.g. FINMA, FATF), *industry bodies* and related *associations* (e.g. Swiss Banking Association, The Wolfsberg Group). Additionally, it is available and broadly recognized not only by the participants of the financial industry but also across other industries.

According to our research, the preferred solution of the industry and public is a government-issued or government-verified E-ID ([3]).

Interfaces between different DLTs and external systems have been established, with APIs being implemented to interact with the systems of other countries and organisations. Furthermore, digital identities are possible not only for natural persons and legal entities, but also for things (e.g. IoT devices) and Decentralised Autonomous Organisations (DAOs).

[3] Summary of the public consultation for a Swiss E-ID (in German), p.5, (11/2021): “Unbestritten ist die in den Motionen geforderte Ausstellung der E-ID durch den Staat.”



Cyber & Token Security – Safeguarding Digital Assets

Introduction

Strong security is paramount to protect the client's digital assets and to ensure that only authorised parties can read the content of tokenized assets and transfer them. The used security measures should at the same time be rigorous enough to prevent any misuse by third parties, allow clear identification of the ownership of a tokenized asset, be simple to use for clients and protect from loss and theft.

Current Situation and Problems Facing Today

Many security challenges have already been solved for tokenized assets due to the underlying blockchain technology. One of the key features of blockchains is that the stored data is tamper-proof. Once data has been included in a block, it can no longer be altered without affecting the subsequent blocks, thus making the altered block invalid. Any such alterations will be rejected by the blockchain.

- As outlined in the chapter on KYC, the client should be the *sole owner* of all information stored in the tokenized assets about this client. Any tokenized asset is linked to a public key, and following the principle of public key cryptography, only the person holding the corresponding private key can claim ownership of the token.

- The private key must be protected and stored securely by the client. If a private key is stolen, someone else can claim ownership of the tokens belonging to the associated public key. If a private key is lost, it cannot be recreated, and the tokens belonging to the associated public key are lost as well.

- The associated data of a tokenized asset (i.e. metadata) is stored in plaintext format. Everyone can view the content of any tokenized asset by consulting a public explorer for the blockchain in question. While this is fine for some information, some data, like the outcome of a KYC process and especially the personal data of the token holders, shall not be visible to anyone.

- Tokenized assets are not linked to a client via name and address as is customary for bank accounts, documents, etc. today. Instead, blockchains use public key cryptography and are anonymous respectively pseudonymous. Ownership of an account or token can only be proven via the private key held by the owner. This makes it challenging for financial institutions to map tokenized assets to a certain client. As outlined in the chapter on Know Your Customer (KYC), the client must be the sole owner of all information stored in the tokenized assets about them. Certain data, such as the outcome of a KYC process and the personal data of the token holders, should not be visible to anyone.

Vision

We envision a solution and ecosystem with the following best practices for safeguarding digital assets:

- *Access control:* retail or institutional clients decide which person or financial institution can retrieve their tokenized assets, have access to their respective custody provider and view the content of a token.
- *Private keys* can be stored securely and linked to a client by a financial institution or intermediary of the client's choice to be able to retrieve them again by providing sufficient proof of ownership, like a passport. Establishing the link between a client and a private key should not be possible without the explicit wish of the client.
- *Cold storage:* consider using cold storage solutions for long-term asset storage. Cold storage involves keeping your private keys offline and away from internet-connected devices, reducing exposure to potential cyber threats.
- *Custody providers:* the increasing adoption of digital assets by institutional investors and TradFi institutions, will also lead to an increased demand for secure custody solutions. Hence, more players will enter the market of custody providers in order to meet the rising demand. Moreover, custody providers (i.e. Metaco, Fireblocks, Coinbase Custody) will (further) develop platforms which are at the intersection of three tech areas: cyber security, AI and blockchain. Custody-as-a-Service (CaaS) models will emerge and enable companies to offer white label custody solutions and allow them to focus on their core competencies without developing custody infrastructure of their own.
- *TradFi Partnerships:* in the near and long term future we will see TradFi institutions starting to collaborate intensely with custody providers to offer digital asset custody services to their clients.
- *OTC desks & Liquidity Providers:* over the counter (OTC) desks and liquidity providers may partner with custody providers to ensure secure management of assets.
- *Secure Network & Devices:* the devices used for the storage of the private keys need to be kept secure, updated and the data saved on the devices needs to be regularly backed up.
- *Insurance Coverage:* to address concerns about potential loss of digital assets, custody providers may offer enhanced insurance coverage to protect against cybersecurity breaches or operational interruptions.

Main elements of the vision

After setting the scene by introducing the ecosystem as well as some contextual elements, which act as prerequisites, this chapter explains the six main elements of the Vision of Tokenized Finance. For the time being only six elements are discussed in detail. However the box “Others” clearly implies that there may very well be additional elements in future. This fact therefore acknowledges the dynamic and fast moving pace of the industry. Some of the following elements are in some ways interrelated and have overlapping characteristics, requirements and relations among themselves. All elements are however treated separately. They are composed and written by independent experts. Chapter Conclusion & Outlook condenses and summarises all findings.

This chapter is structured along the chronology of tokenization. Firstly, tokenized assets need to be issued. Only then custody and safekeeping becomes a vital issue. Trading these assets and paying for them follows in due course, while lending and staking are still among the more recent developments of the industry and therefore will be introduced last.

Figure 5 - Main elements of tokenized finance

Issuance / Primary market

Introduction

Issuance is the process of creating - or minting - digital assets. The issuance process highly depends on the type of digital asset being minted. The reason for that mainly lies in the different legal and regulatory requirements. Purely from a technical perspective however, any person in the world with the right tools at hand can mint a token within minutes. Such tools are broadly accessible.

The token itself does not confer any rights to its holder without a legal framework, so any token issuance system must put the technical capabilities to issue tokens into the correct legal context. Switzerland has a progressive DLT-law, enabling companies to issue securities in the form of tokens. In addition, Switzerland is home to SIX Digital Exchange (SDX), one of the first central securities depositories (CSD) powered by distributed ledger technology, which allows tokens to be issued in accordance with the Swiss intermediated securities law. Moreover, other companies such as Aktionariat, Daura, Trustwise, and Sygnum have already entered the market offering tokenization services.

Equity securities are a prime example of the coupling between technical capabilities and legal requirements. Equity securities typically are issued at incorporation or at capital increases of companies limited by shares and they are tightly linked with the Swiss code of obligations.

The issuance of equity securities involves a combination of pre-issuance processes that must adhere to the legal context, followed by the technical act of issuance itself. Prior to issuing a token, which is synonymous with an equity security as per Swiss DLT-law, the company’s management must take multiple steps. If a capital increase is involved, this includes obtaining consent from existing shareholders, finding an investor base for the new shares (“placing the shares”), and registering the valid capital increase in the commercial register. These pre-issuance processes are distinct from the technical act of issuing a token, and will benefit from tokenization. This will make it less costly, time-intensive, and cumbersome for companies to raise fresh capital in the future, as processes such as collecting consent, handling preemptive rights, handling subscriptions for new shares, and handling different share classes with various rights will be facilitated.

Avoiding having several financial intermediaries involved to issue equity and debt securities as it is often done today in the public capital markets, would help to lower the barriers for raising capital, especially for small businesses. Such businesses currently only had limited access to broader capital markets. Historically, this fact has been accentuated as financial institutions are frequently selective in the choice of target customers, focusing on enterprises that meet certain volume standards and can afford to raise capital through the issuance of equity or debt securities.

Therefore, smaller companies often found that the effort, cost, and time involved in raising capital through the capital markets outweighed the benefits. Typically, a company's funding journey begins with incorporation or pre-money funding in the private market, followed by a seed and several series of funding, and, if successful, culminates in a public offering with a more mature company. Throughout all of these stages, a multitude of parties interact in different roles on different marketplaces, creating complexity and a burden for the company looking to raise capital.

A look at the issuance process today

Today's issuance (including pre-issuance) process mainly consists of four steps involving several of the intermediaries mentioned before. In principle, an issuance (including pre-issuance processes) consists of the following steps today:

- *Deal preparation and structuring:* The issuer, regularly together with partners, defines his needs in financing and structures the deal accordingly.

- *Investor documentation:* The issuer, often together with partners, prepares an investor documentation. This documentation has varying degrees of sophistication, depending on the placement character (targeted investors, targeted capital amount, etc.). Service partners often perform heavy due diligence on the company before they would propose an offering to potential investors. In other cases, investor documentation only consists of a pitch-deck.

- *Distribution:* The issuer, often together with partners, first finds a pool of potential investors with the aim to secure a firm commitment. This process highly depends on the needs of an issuer. Some issuers are looking "only" for capital, in which case their primary objective is to find capital in the most efficient way (equity or debt). Other issuers, often younger companies, are looking for "smart capital", in which case their objective is to find capital (typically equity capital) from investors which have a strategic relevance for the company (e.g. through network, expertise or other non-financial incentives).

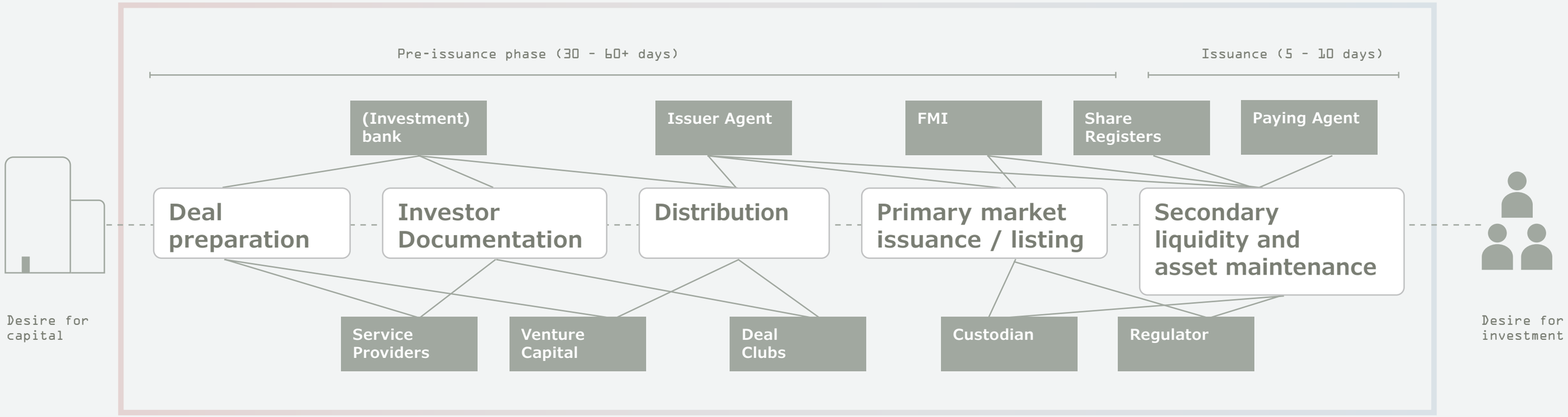
- *Executing the placement:* The last step includes legally finalising and settling the placement. And lastly, from a technical perspective the actual issuance (minting) and allocation of the tokens takes place.

Today, emerging digital platforms allow companies to place digital assets without involving any third party, other than the digital platform provider. This form of financing, commonly referred to as "crowd-funding," may have limitations due to the fact that the distribution process is left to the issuing company. On the other end of the spectrum are more traditional transactions, which are heavily intermediated and require multiple parties to manage the complexity of the placement. These transactions often adhere to traditional processes which have been developed in the context of IPOs and require careful collaboration and coordination of activities as well as a lot of manual processes. The issuance process for such transactions typically involves a large number of parties connecting investors and issuing companies, including banking intermediaries, service providers, and financial market infrastructures.

Challenges facing issuance today

Each step of the issuance process is highly customised to the needs of an issuer. These needs, however, may change over the lifecycle of a company. There is no one-size-fits-all process to cover every individuality of each issuance/placement. This variety of requirements has so far limited a further reaching standardisation of processes. Therefore, processes are often carried out manually with limited digital support. Moreover, the reconciliation efforts among the involved parties is considerable. For example, to perform due diligence, multiple parties often require access to the same data. This data is often unstructured and potentially erroneous. As a consequence, each party will re-structure and validate data to its own needs. This leads to a processing overhead and data duplication with all related challenges to maintain data integrity (reconciliation). As mentioned before, investor KYC'ing is another example: It may be the case that one and the same investor is "KYC'd" by multiple parties in varying degrees of sophistication individually (e.g. issuer and distributor).

For equities, the issuance of new equity securities (STO) is often tightly coupled with already existing equity securities. Existing equity securities may carry preemptive rights which entitles existing shareholders to buy units of the new issuance first. Furthermore, different share classes may carry different entitlement rights. Drag-along and tag-along clauses are typical examples. An issuance of fresh shares therefore requires careful analysis of the current as-is situation with regards to entitlements. Furthermore, historic transfers of shares have often been badly documented, which requires detailed investigation before an issuance of fresh shares. The reconciliation of the current entitlement situation and of past transfers is often time-consuming and costly. It involves cumbersome, manual investigation by high-skilled staff.

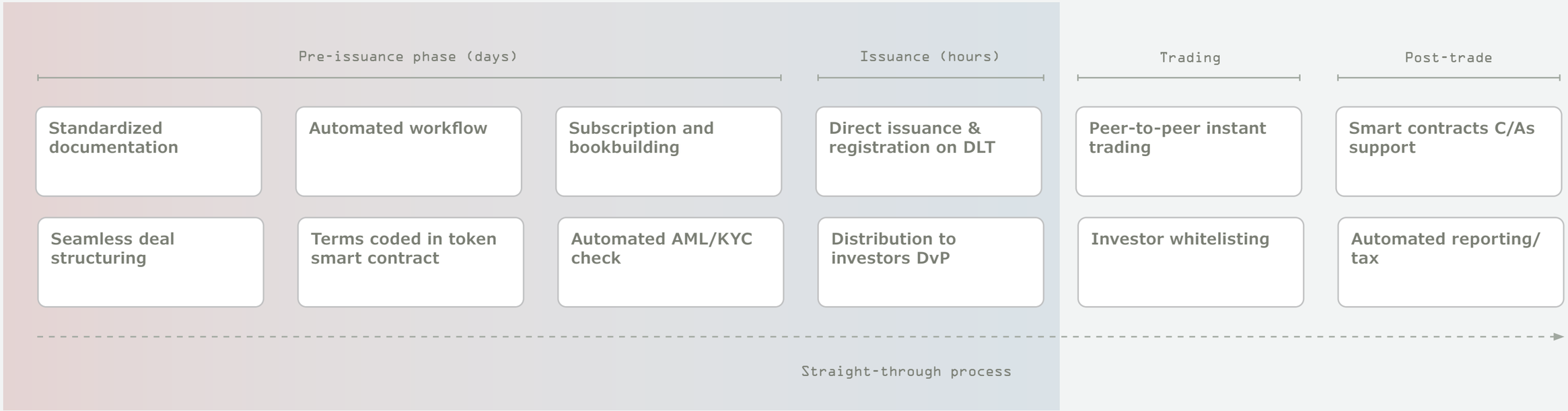


Opaqueness and liquidity fragmentation are further elements which inhibit efficient match-making between companies looking for capital and investors, mainly in private markets. Naturally, capital is drawn towards the best opportunities. Those opportunities are typically well served and benefit from the attention of financial ecosystem actors which in most cases results in successful match-making. However, an extensive due diligence usually is only worthwhile for transactions of significant volume. Reducing operational cost for performing due diligence would therefore serve smaller-sized opportunities, increasing market access to a broader investor base.

Vision of issuance

In a world of tokenized finance, assets are natively issued on multiple business networks based on blockchain technology. Tokens representing these assets are equipped with business logic and data privacy mechanisms, allowing for specific information to be transported and disclosed on a need-to-know or proof basis. Furthermore, tokens will be embedded in a legal context that is transparently visible to each investor, so that they are aware of what type of token they are purchasing, and the associated rights that come with it. Business networks will be connected to allow streamlined and effective processes, with intermediaries and service providers being part of these networks and offering specialised token-enabled services. For instance, based on an interconnected network of tokens representing different asset classes, participants could specialise in token valuation, a service that is beneficial for both issuers and investors, and which could be performed entirely within a token-economy.

This results in *lower barriers to entry* and a simpler, quicker and consequently *cheaper service for issuing* companies looking to raise capital and find investors. Another positive consequence concerns the pre-issuance administrative activities. These will benefit by the necessary digitalisation efforts around the tokenization of assets. Analysis of current entitlements will be conducted by the click of a button, based on logic embedded into



the security tokens. For example, a company, which has existed for several years, has multiple share classes in place with different entitlements. By the click of a button the company can run a simulation of different scenarios for an additional equity capital increase. The execution of entitlements will furthermore be enforced automatically by the business logic embedded in the smart contract that can self-process the execution in a secure and trusted manner.

Investors will be able to invest into a much broader universe of investments. This will *open access to additional investment opportunities (in particular to private equity)*, while continuing to benefit from *investor protection measures*, is one of the key benefits of tokenization and the vision at hand. Increased automation in processing and compliance, while reducing the cost of asset structuring and distribution, will allow the flexibility to define new financial products that were prohibitive before. This could for example allow investors to access dynamic market segments such as targeted regional investment opportunities in specific industries (e.g. support the funding of companies developing heating solutions in a specific region of Switzerland).

Financial institutions and infrastructure providers will increase their efficiency and diversify their service portfolio in order to target new customers and accommodate different investment preferences. During the issuance process, as well as subsequent trading activities, financial institutions will provide services that are not currently available (either not at all, or not from financial institutions) or are utilised only internally. Examples of such services are those related to identity management and authentication, which will be essential in the vision of tokenized finance to guarantee that *authorised digital identities* have access to the relevant digital asset tokens (see also the section on KYC).

Finally, in a world of tokenized finance, *the issuance process will gain more importance*. It is through this process that digital asset tokens are created, independently of whether these are financial instruments, securities or other types of assets. In order to reap the benefits of this vision, it is important that *digital assets are issued natively* in an environment embedding the relevant ecosystem instead of creating tokenized representations (also called “layer 2” assets) of underlying traditional assets, which are still bound to today’s complexities and inefficiencies. In addition, the link between the tokenized asset and physical good needs to be ensured by a legal framework. Such co-existence of native digital assets and non-native digital asset representation will only be an intermediary step during the transition to a vision of tokenized finance where *all assets are based on decentralised ledgers*.

Custody & Safekeeping

Introduction

Custody has been a fundamental pillar of the traditional banking sector since the 1960s. Besides processes, services (reporting, compliance-checks, KYC, etc), custody services also are relying on respective IT-solutions. For tokenized assets, the need for highly secure hardware is given by design. As a consequence, usage, operation and integration of those specific components and processes in daily life - in the different journeys and use-cases of the investors and asset-owners will become commodity.

In the digital asset industry, third-party custody providers offer services to safekeep private keys to crypto assets to meet the demands of investors for comprehensive services, strong processes, secure technology and protection similar to that offered for traditional assets. There are two main custody systems: self-custody and third-party custody. Self-custody involves an entity or an individual holding and controlling their own private keys, while third-party custodians can be either regulated or non-regulated. This paper focuses primarily on regulated financial institutions, such as exchanges, custodian banks or digital asset managers, as custodians.

The existence of a reliable, well integrated and 'easy-to-use' custody infrastructure is often deemed critical for the mainstream adoption of digital assets. Extensive media coverage of investors losing access to their private keys, of hacks and scams, seems to be fostering the demand for reliable third-party custody services.

In this part of the paper, we examine the inefficiencies in the current market and how these may be addressed – ideally solved – with our Vision of Tokenized Finance.

Parties involved in custody

In a typical custody setup, multiple entities / parties are involved. The constellation depends heavily on the industry and business of those parties. The following actors may be involved:

- *Financial institutions* (banks, hedge funds) or other institutional investors (family offices): they may choose to safekeep their assets with a specialised third party provider or to build their own custody infrastructure.
- *Insurance providers:* Certain insurance providers may provide coverage for client's assets. Typically, this is capped at a certain amount[1] and limited to a certain amount of loss.
- *Exchanges:* Exchanges are managing large sums of digital assets which their clients either hold on the exchange or use to conduct trades.
- *Individuals:* Individual holders of digital assets may choose to either hold their funds on their own wallets, or safekeep these with a third-party provider such as a crypto bank.
- *Regulators:* Regulators may require custodians to hold assets in a certain way, or may require certain levels of insurance coverage.

Overall, the custody constellation is highly dependent on the industry and business of the individual parties.

Challenges facing custody today

There are numerous challenges confronting the custody space. The issue of inheritance and proxies is still a major problem today: as only the investors ‘possess’ - has access to and control of - the private keys governing their assets, these assets will be lost forever if the investor becomes incapacitated or dies[1]. To address these issues, third parties such as banks or notaries are currently employed, introducing a human element and thus a lack of efficiency and a potential attack vector to the system. Under the present system, investors are not completely free to choose where to keep their digital assets.

They can either use a bank or cryptocurrency exchange to deposit their cryptocurrency and relinquish ownership of the private key, or they can maintain their own hard- or soft wallet, which requires a certain level of technical affinity and knowledge.

The fact that most banks are operating on legacy systems presents serious restrictions to the ease of integration of their digital asset services. Integrating digital assets into today’s core banking systems can be challenging and complicated due to major topics such as tax-reporting, asset-valuation, new use-cases (i.e. staking, lending) and seemingly minor issues such as the number of decimal places or a much faster settlement process than is currently used for traditional assets.

There is a lack of open systems to put into effect cryptocurrency offerings, leading to higher costs and a lack of transparency. Once a financial institution embarks on a digital asset custody journey, they soon realise that substantial changes to their current processes will be necessary.

The handling of digital assets currently involves a multitude of manual processes in order to adhere to the applicable laws. This begins with the onboarding of a client, which necessitates the execution of a comprehensive due diligence, Know Your Customer, and Anti-Money Laundering procedures.
If the client’s digital asset wallets are included in the process, research into the addresses, funds, and their origin must be conducted. Once a client is onboarded, the processes involved in buying and selling digital assets are more complex than traditional banking transactions, as several individuals are responsible for the approval and settlement of the transaction. Reconciliation with the core banking system is still mostly done manually. There is presently no compliant, standardised solution that is entirely automated, resulting in a great deal of inefficiencies. Additionally, there is a widespread uncertainty regarding the legal status of digital assets and the current legislative situation. This has led to many institutions refraining from providing services for the custody of digital assets. The digital asset space is evolving quickly, which creates a challenge for banks and other financial institutions as they attempt to keep up with the most recent developments; be it new security features or the introduction of new tokens and assets that clients demand.

Custodian of the future: asset transfer with compliance and assets' recoverability

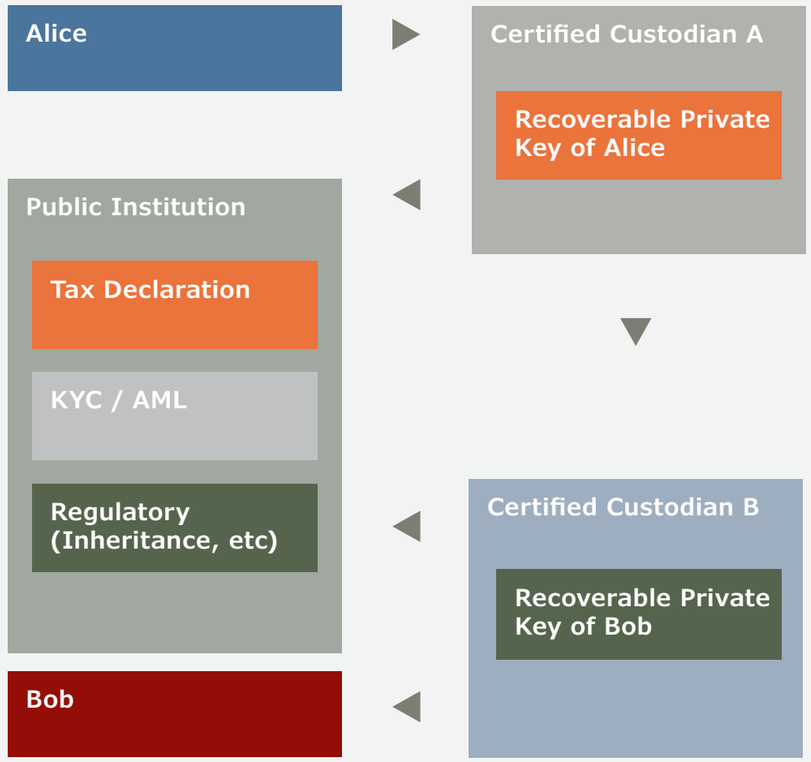


Figure 6 : Process of transaction between Alice and Bob, illustrating the relationship between Alice, Bob, the Certified Custodians and the Public Institutions and the tasks each is performing in these transactions

Vision of custody

Vision of custody related products: Freedom of custody choice

The regulation of custody service providers is essential to meet - besides the fulfilment of regulatory boundaries - the needs of the various stakeholders in the market interested in using crypto services and tokenized assets. It allows for the exploration of business opportunities in a rapidly growing and constantly evolving market, as well as facilitating broader financial inclusion. These services are expensive to establish and maintain, mainly due to the need for frequent technological updates, stringent KYC and Due Diligence requirements, and specialised knowledge and experience. Additionally, the use of private keys presents a variety of risks that can be mitigated by stringent, unified, and appropriate controls and protocols across the entire life cycle of the assets. Established companies, such as banks, can ensure that regulatory and security standards are met, while also providing extensive knowledge and experience in custody services. For this reason, many investors would prefer to use their traditional custodian (bank) if they were offering custody services for digital assets.

This solution appears to be well-received; however, it should not be the only one available, as investors should still be able to choose where to keep their assets. Therefore, the principal issue that needs to be addressed in relation to third-party custody services is the implementation of regulations. To ensure smooth transfers, security protocols and to allow anyone to become a centralised custodian of crypto assets, there must be an established set of rules and processes (such as Know Your Customer) that must be adhered to, while taking into account the associated risks and the ever-evolving nature of technology.
To summarise the first part of the vision for the custody of tokenized assets, investors should always have the freedom of choice: the owner of the digital assets can select from a variety of methods for safeguarding their assets and respective keys.
There are two main ways of going about this:

- *Self-custody* (incl. all kind of different variations of wallets):Depending on the usage, self-custody can prove to be a faster and more flexible custody solution, such as in the cases of cash pooling or for anonymity reasons. While adhering to regulatory and compliance regulations, investors can store and exchange assets using their preferred method. Through the implementation of an efficient KYC process and transaction monitoring rules, assets can be transferred to and from a third-party custodian at any time.

- *Custody with a FINMA regulated party: Custody of* funds (i.e. fiat, crypto or CBDC) and tokenized assets such as listed assets, private equity assets or other physical tokenized asset (such as a tokenized flat, car, etc.) can be stored with a regulated custodian, instead of having to be safe kept by the owner themselves. The owner of the digital assets is responsible for safekeeping their assets.

The responsibilities and risk/reward structures are transparently communicated in a simple way, for example questions: At whose risk are the assets stored? Is the intermediary responsible and liable for missing assets and if so to what degree?

- The Custodian enables a straightforward and user-friendly way to utilise shareholder rights and other similar rights associated with the underlying assets, including all corporate actions and the fulfilment of information requirements. The Custodian shall provide aid in documenting the fiscal documents of the held assets.

- The ultimate goal is to have the capability to *directly report the values of a parties's crypto assets to the tax authorities*. Information is only provided on a need-to-know or proof basis. To enable extra use cases such as lending, the Custodians will enable various forms of escrow services for digital assets.

In the Business to Business (B2B) sector, these are:

- Custody services for tokenized assets (i.e. Custody-as-a-Service) can be purchased “off-the-shelf” through platforms such as Platform as a Service (PaaS), Software as a Service (SaaS), or Infrastructure as a Service (IaaS).

- There will be clear guidelines and regulations to provide physical custody services for tokenized assets. This includes, for example, processes and standards for custodians of physical art objects that have a digital counterpart, which is presented in a tokenized form (which could be a fungible or non-fungible token).

Lastly, the industry will need to address custody aspects regarding tokenized assets with tangible assets as underlyings:

- In the *mid-term*, we need clear guidelines on how to safekeep tokenized physical objects on behalf of their owners.

- In the *long-term*, we envisage to transform public registers (e.g. land registry i.e. Grundbuch) into digitally accessible ledgers.

Risks facing custody:

Despite the abundance of professional custodial solutions providers on the market, potential providers should be mindful of certain risks before undertaking this venture. These risks include:

- *Hacks and vulnerabilities:*
  There are numerous hacks and vulnerabilities associated with crypto-related hardware, making it an attractive target for attackers. Therefore, it is essential to conduct extensive research on potential vendors and service providers, and to consider penetration testing or obtaining third party security reports.

- *Human element:*
  Any company entering the blockchain space must take into account that human involvement is always a factor to consider, indicating that personnel managing key management solutions could approve erroneous transactions or lose private keys. Consequently, any successful solution must automate as many sources of error as possible so as to eliminate human error.

- *Vendor lock-in / dependence:*
  A Distributed Ledger Technology (DLT) is composed of databases, business data, rules, and workflows. Traditionally, databases were managed by businesses, and software was provided by vendors. However, most DLT solutions are provided by DLT vendors, who are responsible for maintaining and upgrading the solution. If the DLT vendor fails to keep the platform up-to-date and accurate, the DLT is vulnerable. Moreover, if the DLT vendor employs proprietary standards, it could be costly to migrate to another DLT technology as a result of the refactoring work that must be completed beforehand.

- *Cost of hardware:*
  Institutional-grade hardware can be costly, and in order to guarantee a secure set-up, multiple pieces of hardware need to be acquired, making it impossible to reduce the expense. As such, the company must consider these costs when creating their budget.

- *Auditability:*
  Most solutions must undergo auditing to be compliant, particularly financial institutions, which may require an audit report that covers hardware, key generation, key management, smart contract auditing and related processes for regulatory compliance.

- *Insurability:*
  For some of the above risks, insurance companies might be able to provide coverage in the future. However, today only few insurance providers offer relevant services at high rates.

Future comparability of custody solutions

Currently, there are various methods of safeguarding digital assets and tokens, and it is expected that this will remain so in the future. To enable investors to make an informed decision when selecting a custody option, and for providers to clearly position themselves on the market, the digital asset industry and/or regulatory entities should establish a simple system for assessing the different custody options. This system should include different dimensions such as *security levels, types of tokens covered, extent of reporting, usability, and client segments* (i.e. private, professional, institutional). For example, a simplified version to categorise different custody solutions could use a similar labelling system to that currently used for electronic appliances (A – E).

Payments

Two payment use cases will be discussed in this chapter:

- *Programmable money payment* – linked to Internet of Things (i.e. pay-per-use, trading use case, machine-to-machine payment)
- *Merchant payment* (online or physical point of sale): the user experience and settlement process (back-office execution)

Hence, the payment use cases described in this section are different from the ones of the payment leg and of the DvP in trading of digital assets. These will be discussed in the Chapter “Trading”.

Current Situation:

Digital assets are becoming a more and more important part of the payments world. Gradually more retail customers are using payment cards to buy crypto assets and it is also increasingly commonplace to have the option to convert the digital assets for everyday use into fiat. Hence, it is the payment’s industry responsibility to enable customers, merchants and businesses to move digital value in form of digital assets or fiat as user friendly, reliable and secure as possible.
This will create a lot more new possibilities for shoppers and merchants, allowing them to transfer value in an entirely new way. Not all of today’s cryptocurrencies will still exist in the coming years. We expect consumers and institutional clients to adopt digital assets that offer a high reliability, security and low volatility.

Overall we encounter nowadays different forms of payment which are enabled by the stablecoins. Simply because they are stable in value and denominated in US dollars or Swiss Francs, they represent a fast way to move value from one place to another and positioned as an alternative to fiat nowadays. On the other hand, CBCDs represent an opportunity for central banks to upgrade their payments infrastructure and take advantage of digital currencies.
The whole world of DLT, digital assets and tokenization started with a payment token called Bitcoin. In the meantime the payments area evolved, so that stablecoins (i.e. USDT), retail CBDCs ([4]) and different crypto currencies became more and more popular in the past 5 years. However, only few tokens are currently being widely used:

- Crypto-currencies such as Bitcoin are still too volatile to be used as an everyday means of payment. Exceptions are countries with a very high inflation and very volatile fiat currencies (i.e. El Salvador and the Central African Republic introduced Bitcoin recently as legal tender)
- A lot of private stablecoins are already available, even ones that are pegged to CHF.Nevertheless, they are still under-regulated to have a large institutional adoption.
- Some retail CBDC’s have already been implemented. Nevertheless, the conceptual design of retail CBDC’s of advanced economies are not yet ready, and even numerous central banks aren’t enthusiastic to the idea of developing a retail CBDC, as the SNB that focuses on the wholesale CBDC.

More and more payment service providers allow customers to settle their purchases at the merchants with their token, stored either on a custodial or non-custodial wallet. Solutions are already set to have a seamless experience for the customers and merchants at the point of sale, nevertheless the processes behind are still mainly based on traditional finance railways, as the merchants usually receive their money in fiat currency, and may still involve some time in between the merchants being really paid for.

Programmable money for corporations to optimise their business model in the physical economy is already available within public DLT or can be built with partners on private blockchain. Nevertheless, the use cases are still limited and are mainly at the POC level. The lack of an institutional grade means of payment may be the main cause of this absence. Nevertheless, the scarcity of the highly technical skills needed to develop those cases and the lack of immediate business potential may also restrain the current development.

Financial Markets

Globally, the competition for crypto is intensifying. Binance received regulatory approval to operate in France, Lugano has partnered with Tether to turn the city into the “European Capital of Crypto” and BitMEX entered Switzerland.
Last year, the total crypto trading volume ballooned to CHF 103 billion (Oct. 2020- Sept. 2021, Institute of Financial Services Zug IFZ), a drastic rise compared to just the previous year. Direct investments through exchanges such as Binance and Bitstamp and through the 15 largest central exchanges amounted to CHF 92.6 billion.
According to Financial Times (Apr. 2022), there are currently 960 crypto start-ups in Switzerland and last year, the Swiss Financial Market Supervisory Authority (FINMA) granted regulatory approval to SEBA and Sygnum (banking), as well as to Crypto Finance and Taurus (securities).
Switzerland is not the only country adopting crypto payments but it is one of the most open and stable.
Today more and more traditional financial institutions are getting onboard with the technology, accepting clients who are crypto native in addition to offering more payment and acceptance services across the fiat/crypto divide.

Products

New solutions are now available to allow consumers to purchase and spend digital currencies in an easy and seamless way. Solutions such as crypto wallets and crypto cards are becoming widely available across Europe, enabling an easy way to spend crypto assets in an everyday setting.
New payment solutions also allow merchants to accept digital currency payments from POS or e-commerce. This is also becoming increasingly available, enabling seamless customer spend without conversion into fiat.

[4] Bank of Mauritius, Public Consultation Paper on the CBDC: the digital Rupee,

In the future, solutions allowing interoperability will be key in enabling user experience and payments across multiple types of digital currencies (i.e. CBDCs, stablecoins).

Processes: are nowadays cumbersome as crypto partners convert digital assets on their end to traditional currencies, then transmit them through to the corresponding payment network.

Institutions & Stakeholders: Multiple, non-interoperable solutions are offered by various institutions with a limited digital assets regulatory framework.

Technologies: the offerings for digital (decentralised) currencies are highly fragmented and the standardisation framework is currently not mature.

Cyber Security: public blockchain networks are still prone to cyber attacks, exploits and security breaches.

Legal, Regulation, Standards: the regulation for digital assets is in Switzerland already in place and is continuously being developed.

Environmental & Sustainability: some cryptocurrencies' energy usage may be enormous. However, this aspect has been recently mitigated by means of upgrading from the PoW to the POS algorithm, in the case of Ethereum.

Vision

We envision that the payment landscape and its infrastructure will radically change in Switzerland in the next 10 years.

Programmable money payment: we strongly believe that reliable means of payment are essential for the future development of the whole Distributed Ledger Technology-space.

Not all of today's cryptocurrencies will be used in the future, as many of the hundreds of digital assets in circulation still need to tighten their compliance measures and/or do not have the technological capabilities to develop complex use cases and scale for global use. It is expected that consumers and the ecosystem as a whole will start to rally around the crypto assets that offer reliability, security and a bearable level of volatility. Nevertheless, we don't expect any cryptocurrency to be widely used as means of payment and replace any money in national currency (i.e. CBDCs, or stablecoins pegged to a CBDC).
We do believe that each currency union may have stablecoins pegged to the local currency. Those stablecoins would follow a standardised rule book. The rules will ensure that these new means of payments are as safe as possible. They will entail elements of centralised regulation and will most probably be a commercial bank money token (deposit token). The stablecoins will function based on a decentralised infrastructure and will be fully interoperable with various blockchain protocols. The standardisation and regulation would ensure that the private stablecoins will be fully interchangeable and any economic actor will use it as if there's only one, exactly as nowadays retail clients and institutions use their deposit money at the bank.
Hence, a few stablecoins will exist inside a specific ecosystem, linked to specific economic actors that have specific features for their customers.
Along with stablecoins, retail CBDCs as "electronic cash" might play a role for a broader adoption of a tokenized world of finance. However, this greatly depends on the exact layout of such a solution. Also, at this stage it is hard to say if CBDCs will be usable outside of wholesale use cases ([5], [6]).

When it comes to *merchant payments*, we do not expect the user experience to change significantly. Retail customers will be able to trigger a payment at the POS either with a card or a mobile app linked to their wallet. However, the confirmation and settlement of the transaction will be realised much faster due to the technological enablement of underlying DLT. We expect that any form of stablecoin will be available to institutional clients in order to allow operating businesses in an efficient way and lower the risk of default. Summed up, following aspects will improve and further develop in the short and long term:

Processes: payment networks will support digital assets directly, avoiding back and forth conversion between crypto and fiat money.

Institutions & Stakeholders: local respectively global regulatory frameworks will be put in place, while specific solutions will become standards.

Technologies: the exchange and transfer of interoperable and regulated digital currencies will be enabled by global networks and platforms.

Cyber Security: dedicated cyber fraud prevention and risk tools will emerge and find a high adoption.

Legal, Regulation, Standards: a regulatory framework and global standards providing security & reliability for creating new business models and protecting consumers will be put into place.

Environmental & Sustainability: the technology behind cryptocurrencies will be aligned to environmental & sustainability goals. At the same time we envision carbon footprint calculators integrated for customer transparency in the future payment services.

Major gaps between current situation and vision

The main gap in order for the vision to become reality is the *global regulatory gap*, especially the AML aspect, as well as the *technology gap* since the current decentralised payment solutions are not highly scalable and the blockchains operating the different payment solutions are not yet interoperable ([7]).

In our view, the final design and implementation of a *retail CBDC's* is optional to turn the vision into reality. Nevertheless, the creation of a *wholesale CBDC's* is necessary in order to create interchangeable local currency stablecoins.

Moreover, our group of payment experts identified further gaps between the current situation and the vision formulated:

[5] Project Helvetia, Phase I: Settling tokenised assets in central bank money

[6] Project Jura, Cross-border settlement using wholesale CBDC

[7] Chainlink, Cross-Chain Interoperability Protocol

- *Consumer protection (incl. privacy and security):* more protection for consumers against abuse (i.e. pump and dump) when trading in markets. Leverage technology for data analysis and consumer protection (June 22, FINMA)

- *Strict compliance protocols, incl. KYC:* just last year the Financial Action Task Force (FATF) recommended regulatory updates around virtual assets. Crypto is legal if licensed by FINMA. FINMA requires Virtual Asset Service Providers to provide personal identifiable info (name, account number, address, etc.)

- *Regulation still developing:* the Financial Action Task Force (FATF) regulations on international level. Over 200 jurisdictions comply and implement FATF's regulations. FINMA regulated at the country level.

- *Crypto assets need to offer the stability people need in a vehicle for spending, not investment:* virtual assets companies are required to register with FINMA and comply with its consumer protection regulation.

Trading

Trading refers to the act of finding a counterparty and agreeing with that counterparty on a price for a certain number of units of assets. A central trading venue matches ask and bid orders and therefore demand and supply for a certain asset. The act of trading is clearly separated from the act of transferring the asset and obtaining legal finality on the transfer (i.e. settlement). While for spot markets, per definition, settlement typically takes place shortly after the trade has been concluded, in derivatives markets settlement may be well in the future. This document focuses on spot markets.
For assets listed on a spot market such as a regulated stock exchange, trades today typically are settled within one to three days after the trade. This is referred to as T+X settlement, whereby X is typically two days. For assets which are not traded and settled through the banking system, for example shares of an unlisted company in certificate form, and traded between one shareholder and another investor through a personal agreement (OTC trade). The settlement time of such a trade is usually bilaterally agreed as part of the trade conclusion document (share purchase agreement). Typically, seller and buyer agree to deliver the asset and cash, respectively, in between 7 and 10 days after the agreement. They may as well decide to sign the share purchase agreement (the trade) and the assignment of the certificate (the settlement) on the same day, making it a same-day settlement.

Challenges facing in Trading and Settlement today

The time delay between trade and settlement carries a settlement failure risk for the buyer and seller. At the time of settlement, the seller may no longer hold the securities or choose to not deliver the securities, and analogously, the buyer may no longer have the necessary funding or may choose to not deliver the funding. It may also be the case that one leg of the transaction may already have been delivered, e.g. that a security has been delivered but the cash payment never received (or vice-versa).
Traditional financial markets have established concepts to reduce those risks in the financial ecosystem. On the one hand, central clearing counterparties (CCPs) act as central counterparties to each side of the trade and centralise the risk with appropriate risk mitigation measures. If one party fails to deliver, the CCP covers this risk.
On the other hand, delivery-versus-payment (DvP) mechanisms are common in financial markets. DvP-mechanisms ensure that one leg of the transaction settles if and only if the other leg of the transaction settles too. DvP-mechanisms cannot ensure that the trade settles, however they can ensure that if one leg fails at least both of the legs fail. Smart contracts as used within DLT-systems are well-suited to perform such DvP-mechanisms.

They ensure by programmed code that only if one side of the transaction settles, the other leg will settle as well.
At the same time, in TradFi the trading processes involve multiple intermediaries, which slow down the overall settlement time.
On the other hand, settlement through a DLT-system is often referred to as “atomic settlement”. An atomic settlement ([8]) carries two distinct properties of settlement: One property being the “instantaneous settlement” (i.e. no timing delay between trade execution and settlement), the other being the “simultaneous settlement” (i.e. settling one or potentially multiple legs of a transaction simultaneously with the other legs and if and only if the other leg(s) settles (settle) as well). In other words, the securities will be delivered if and only if the payment has been received.

In order to close the gap between the T+X and atomic settlements, we envision a fundamental change in the way trading is layed out today.

Vision of trading

We expect that the trading landscape in Switzerland, a country known for its favourable regulatory environment and its position as a global financial hub, will undergo significant transformations through blockchain enablement. Some ways on how the trading landscape can evolve are explained below:

- *Trading ecosystem:* will develop much further as today and will have at its centre a new generation of exchanges developed on blockchain infrastructure, like SDX Switzerlands’s first fully regulated FMI exchange for digital assets. Hence, atomic settlements will be possible and the retail and institutional customers will benefit from the fast time between trading and settlement (many activities moving from traditionally post-trade to pre-trade).
- *Regulatory Framework:* Switzerland has been proactive in establishing a clear and favourable regulatory framework for blockchain and digital assets, by introducing the DLT law in 2021. The Swiss government’s continued support for innovation in the blockchain space is likely to encourage the growth of blockchain-enabled trading platforms and services.
- Security and Trust: blockchain’s immutability and security features will enhance the trustworthiness of trading in Switzerland. This will attract more institutional investors and HNW individuals to participate in blockchain-enabled trading.
- *Integration of TradFi:* blockchain enablement will foster greater integration between traditional finance and digital assets in Switzerland. This will lead also to the development of hybrid trading platforms that offer both traditional financial products and blockchain-based assets.
- *Cross-Border Trading:* Blockchain-based trading platforms could facilitate cross-border trading, making it easier for international investors to access Swiss financial markets and Swiss investors to trade global assets.

[8] Michael Lee, Antoine Martin, and Benjamin Müller, What is an Atomic Settlement

The benefits of blockchain enablement for trading in Switzerland are significant. However, challenges related to interoperability, scalability, and compliance will need to be addressed to ensure a smooth and sustainable evolution of the trading landscape. At the same time, standardisation and partnerships will play an important role in shaping the global impact of blockchain on trading.

Lending

Lending is one of the basic mechanisms in finance. Thus, it is not surprising that also in a world of tokenized finance the term respectively the application of lending arises.

Lending of digital assets is a financial service that allows individuals and institutions to lend or borrow cryptocurrencies, typically through specialised online platforms known as crypto lending platforms or DeFi protocols. *Lending in DeFi* is a smart contract-based process that facilitates the peer-to-peer lending and borrowing of crypto assets without third parties. This practice is an important part of the broader crypto finance ecosystem and has gained popularity due to its potential for earning interest on digital assets holdings or accessing capital without selling assets.
The main aspects of crypto lending are:

- *Peer-to-Peer Lending*: Debt can be tokenized in the form of loans provided by individuals or institutions. Borrowers receive tokens representing the debt, and lenders can trade these tokens on secondary markets, potentially increasing the liquidity of the loans.
- *Lenders*: These are individuals or entities that have surplus cryptocurrencies and are willing to lend them out to earn interest. By lending their digital assets, they temporarily transfer ownership to the borrower in exchange for a predetermined interest rate.
- *Borrowers*: On the other side, borrowers are individuals or entities seeking to access cryptocurrencies without purchasing them outright. They often need crypto funds for various purposes, such as trading, investment, or leveraging positions.
- *Crypto Lending Platforms*: Crypto lending is facilitated through specialised platforms that act as intermediaries, connecting lenders with borrowers (i.e. BlockFi, Compound, Aave, Bitfinex, Crypto.com). These platforms handle various aspects of the lending process, including matching lenders and borrowers, managing loan terms, and ensuring the safety of funds through secure smart contracts.
- *DeFi Lending pools:* an essential concept in the world of decentralised finance (DeFi). They are pools of funds provided by various users who deposit their cryptocurrencies into a smart

contract on a blockchain. These pooled funds are then made available for borrowers to borrow from. Borrowers who need access to funds can request a loan from the lending pool. To borrow from the pool, borrowers must typically provide collateral in the form of other cryptocurrencies. DeFi lending platforms that utilise lending pools include Compound, Aave, and MakerDAO. These platforms have contributed significantly to the growth of decentralised lending and borrowing, offering users a range of financial services without relying on traditional financial institutions. However, it's important to remember that while DeFi offers exciting opportunities, it also carries risks, such as smart contract vulnerabilities and potential loss of funds due to market volatility. Users should exercise caution and conduct thorough research before participating in DeFi lending pools.

- *Collateralization:* One common feature of crypto lending is collateralization, where borrowers are required to deposit a certain amount of cryptocurrency as collateral to secure the loan. This collateral acts as insurance for lenders, as it can be liquidated to recover their funds in case the borrower defaults on the loan. In thor context the proof of reserve ([9]) for the collateralization is essential as some default events from the crypto industry showed in the past year.

- *Smart Contracts:* In many cases, the lending platforms use smart contracts to automate the lending process. Smart contracts are self-executing agreements with the terms of the loan coded into them. They enforce the terms and conditions, handle interest payments, and automate collateral management.

- *Custody:* for safeguarding the digital assets borrowed there are two options: sole custody or third-party custody. *Third-party custodians* offer secure storage solutions for digital assets, ensuring the safety and integrity of the cryptocurrencies held by the lending platforms and their users (i.e. Metaco, Fireblocks). *Sole custody* for crypto lending refers to a custody arrangement where a single entity or individual holds complete control and responsibility for safeguarding the digital assets involved in the lending process. In the context of crypto lending platforms, sole custody means that the platform itself is the sole custodian of the cryptocurrencies deposited by lenders and borrowers. It is essential for users considering crypto lending through platforms with sole custody to thoroughly research the platform's reputation, security measures, and terms of service. Additionally, users should be aware of the risks associated with the platform itself, as vulnerabilities or operational issues could impact the safety of their assets.

- *Interest Rates:* The interest rates in crypto lending are typically higher than those in traditional finance, mainly due to the volatile nature of cryptocurrencies and the inherent risks involved. Interest rates can vary depending on the platform, the digital assets being lent, and the demand for borrowing that particular asset.

- *Tokenized debt:* as mentioned tokenization refers to the process of converting real-world assets, such as debt, into tokens on a blockchain. These tokens can then be bought, sold, and traded on various blockchain platforms. Tokenizing debt offers several potential benefits, including increased liquidity, fractional ownership, and streamlined settlement processes. Here are some ways debt can be tokenized:

  - *Tokenized Bonds:* can then be traded on cryptocurrency exchanges, allowing for greater accessibility and liquidity.

  - *Peer-to-Peer/DeFi Lending:* Debt can be tokenized in the form of loans provided by individuals or institutions. Borrowers receive tokens representing the debt, and lenders can trade these tokens on secondary markets, potentially increasing the liquidity of the loans.

Vision of Lending of Digital Assets

It's essential for participants to research and understand the risks associated with crypto lending before participating. As the crypto lending industry is relatively young and rapidly evolving, users should choose trustfull platforms, consider their risk tolerance, and use appropriate risk management strategies. Additionally, users should be aware of the legal aspects of crypto lending.

Crypto lending is promising. As cryptocurrencies gain wider acceptance and become more mainstream, the demand for crypto lending services is likely to grow. More individuals and institutional investors may seek to earn interest on their crypto holdings or use them as collateral for loans. SFTI envisions that traditional banks will start offering lending services for digital assets as soon as the adoption of crypto assets will increase in Switzerland. Some traditional financial institutions have already started exploring crypto lending services or integrating cryptocurrencies into their offerings (i.e. Swissquote, Julius Bär). This trend could accelerate as cryptocurrencies become more integrated into the global financial system and the lending platforms continue to improve their security measures and gain users' trust. Moreover, we envision stablecoins playing a significant role in crypto lending. They provide a less volatile option for both lenders and borrowers, making lending services more attractive and accessible.

Risks and Considerations: While digital assets lending can be a lucrative way to earn passive income, it comes with risks. Lenders risk losing their funds if borrowers default and fail to repay the loan. Borrowers, on the other hand, may face the risk of liquidation if the value of their collateral drops significantly.

[9] Collateralization and Proof of reserve

Staking

The expression “staking” addresses two different terms: 1. staking in relation to Proof of Stake (POS) and 2. staking in the context of lending. While “POS-Staking” refers to a mechanism, which on one hand is a key building blocks of some blockchain protocols, the other meaning of staking refers to the possibility for investors to generate returns on their digital assets. As these two aspects are closely interrelated it is necessary to first have a look at the consensus algorithm called Proof-of-Stake and its difference to the most common mechanism called Proof-of-Work.
In this chapter we will talk only about native crypto assets.

Proof of Work

The first way to mine cryptocurrency was by means of applying the Proof of Work (PoW) algorithm, a mechanism that was introduced with Bitcoin. PoW can be conceived as a huge lottery game where there is a huge heap of tickets and players are frantically trying one ticket after the other until they find by pure chance the winning one. Their ability to find the right one is just a function of how fast their hands can pick and try new tickets from the heap (i.e. their hashing/computational power). With some mitigations it’s fundamentally a winner-takes-all race, where only one miner gets to mine a block and reap the reward, while all the other participants are doing their computations essentially for nothing, wasting in the process a relevant amount of energy. PoW is inefficient by design, not easy to scale, even though L2 Blockchains can mitigate some issues, and the arms race for hashing power makes it no longer democratic and idealistic as it was supposed to be at the beginning. The time when anybody could mine with his home computer is long gone. Nowadays, huge mining pools have completely overtaken the mining process, with dedicated hardware (mining rigs) usually located in countries with very cheap and (non-)renewable energy sources.

Current Situation: Proof of Stake

Proof of Stake (POS) is another mechanism for the creation of new blockchain blocks. With POS new blocks are said no longer to be “mined” but rather “forged”. Instead of having the described “massive lottery game” based on computational power, POS might be conceptualised as a game, where each player is contributing by putting its wealth “at stake”. With a different selection mechanism (i.e. waiting time in queue, amount of wealth staked, random selection) only one miner (validator) is selected per block. The validator puts its wealth “at stake” while doing the computations, which are done only once and then verified by the other nodes in the validators’ circle. If it’s all correct, the validator gets the reward, if there are errors or faults, a part of its stake is taken (“slashing”), a part up to the entirety according to the severity and the malice of the error. This approach is much more scalable, and allows a very efficient, fast and environmentally sustainable operation of the whole blockchain. Cardano, Polkadot, Tezos, Eos and Solana are examples of blockchain protocols with a POS mechanism. Recently Ethereum moved to POS as well. The biggest disadvantage of POS is that there is a certain limit to the openness of the system. As validators need to fulfil specific obligations such as having a node connected with a complex software stack running 24/7, or they risk expulsion from the validators’ list. The most selective condition is having a relevant wealth to put at stake. This introduces de iure and no longer just de facto a “rich get richer” mechanism hard-coded into the system. But, even the previous PoW blockchains - despite their initial promises of freedom and democracy - are highly centralised, with powerful rich-get-richer effect ([10]). *Staking* on the other hand can prove to be a much more open system than initially thought, by allowing consortia of small investors to come together to present their stakes.

Vision of Staking:

Ethereum requires 32 staked ETH, as well as a machine that is constantly connected to the network and updated with the latest software. The custodians have in the context of staking the opportunity of offering new services for digital assets investors like *staking-as-a-service* and hence, pooling small investors together. This was the digital assets of the investors leveraging the managed infrastructure of the custodian. Currently, in the Swiss financial landscape there are already a few regulated exchanges and banks which are offering this type of a service (i.e. SDX offers ETH staking for institutional clients, Swissquote offers SOL, ETH, XTZ, DOT staking). Custodians can offer this service as an investment to private or institutional investors for receiving a reward (APY). This can represent an additional source of income for custodians, as they can keep a share of the interest for themselves. In addition, custodians can offer pooling for smaller investors or node services for the institutional investors who don’t want to have their machines connected. This is not much different from the small interest rates offered by banks, with the guarantee that the custodian will avoid slashing events. As a new use case, new insurance products can be launched in order to offer to mitigate the unforeseen case of a slashing.

At the same time, Switzerland-based decentralised finance projects and *staking pools* can merge to provide services to a broader audience. The platforms can facilitate staking for various cryptocurrencies, making it accessible to both retail and institutional investors.

Furthermore, we envision the *integration of staking in TradFi*. For example, investment funds in Switzerland will consider allocating a portion of their portfolio to staking as an alternative investment strategy.

Moreover, as cryptocurrency market matures and *institutional interest* grows, more Swiss-based institutional investors and funds will explore staking as a way to participate in the blockchain industry and potentially earn passive income.

If SNB will move forward with the development of a CBDC, staking mechanisms will also be considered as part of the consensus model for the CBDC network.

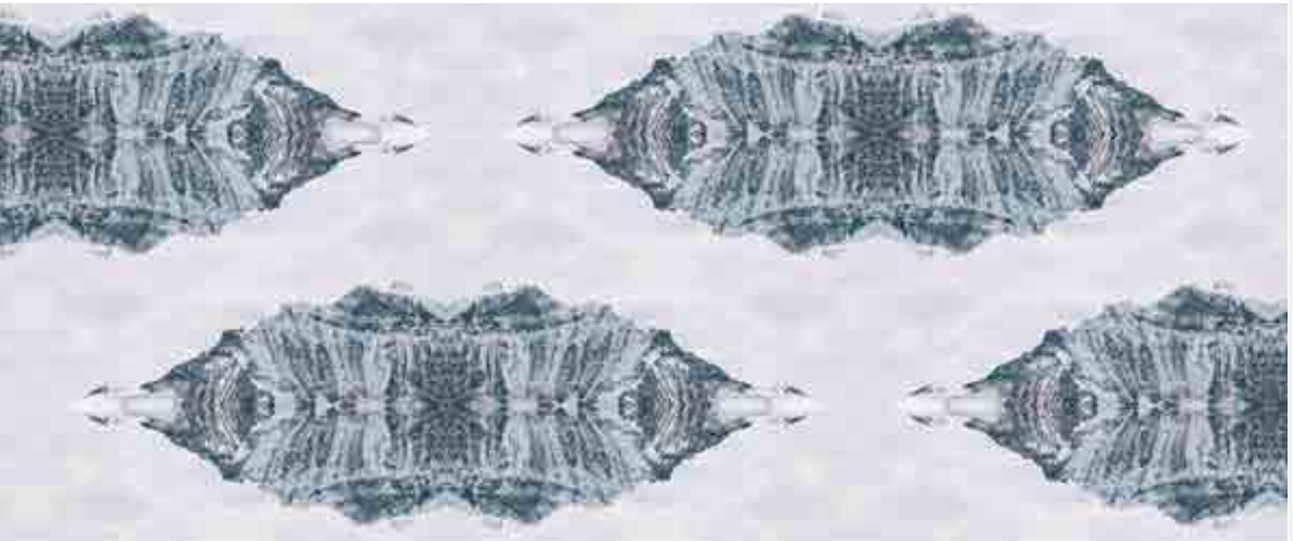
Switzerland’s proactive stance on blockchain regulation will lead to further *regulatory clarity* and encourage more retail and institutional investors to participate in staking.

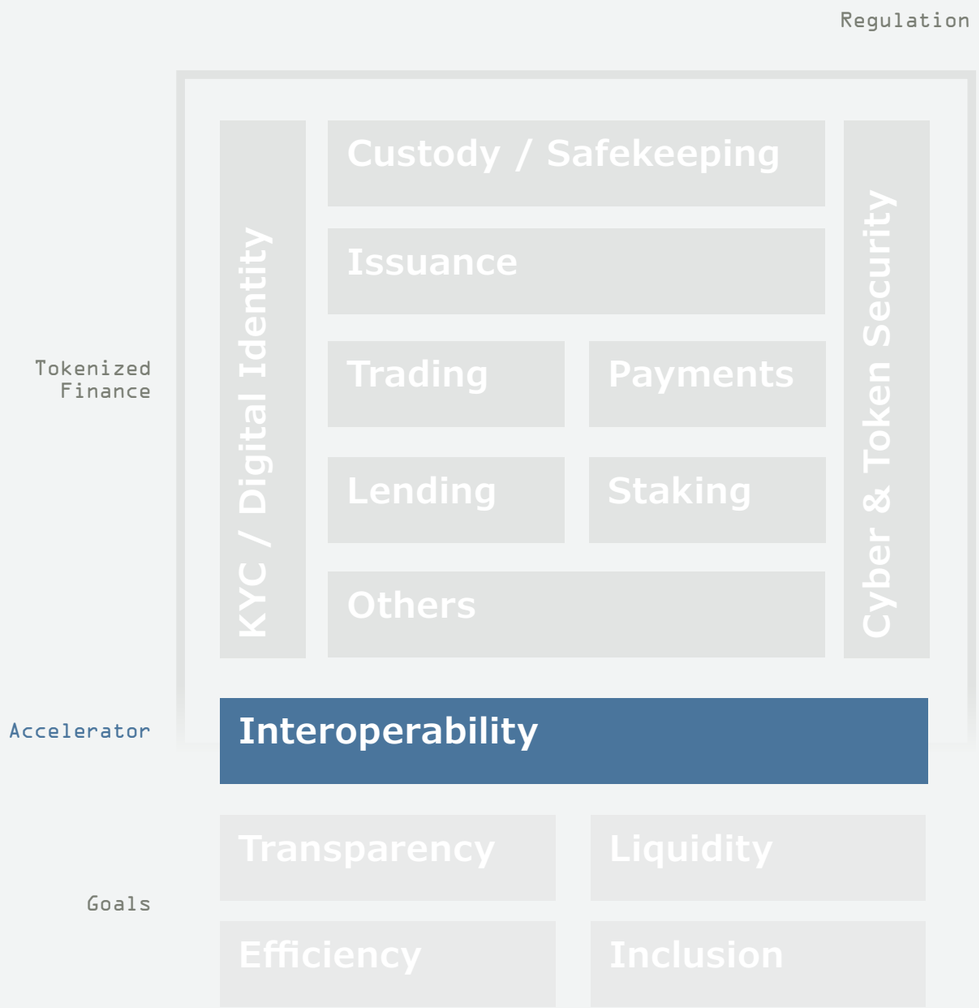
[10] Campajola et al, The Evolution Of Centralisation on Cryptocurrency Platforms

Accelerator: Interoperability

Interoperability and it’s importance for tokenized finance

Tokenization will create global markets for assets and rights that have so far been unbankable due to issues such as limited liquidity, geographical inaccessibility, and cost. In order to facilitate a wider tokenization of assets and to realise the associated potential benefits (including *transparency*, *efficiency*, *liquidity* and *inclusion*), it is necessary to enable interoperability between platforms and ecosystems. Interoperability is at least in the short- to medium-term the accelerating *element of the Vision of Tokenized Finance*.





The simplest way to enable interoperability is to use the same standards and underlying technologies across all platforms and ecosystems. Currently, most financial institutions maintain their own ledger or platform, making the transfer of financial products or assets costly and time-consuming. Additionally, in a tokenized world, new information networks and trusted data sources will be added to verify the validity of the asset. Some financial products may be valued based on external data on which they depend. An example of this could be applications that promote carbon emission reduction. Many of their associated incentives and benefits are based on data points that are observed or generated by different participants of the network. We therefore envisage that APIs will play a more central role in achieving interoperability between different platforms and ecosystems. By introducing standard sets of APIs, we could allow the exchange of tokenized assets and rights across different standards, platforms and implementations. These standard APIs must follow certain principles, which must be established early on to ensure the further development of the ecosystem and to ensure equal participation rights.

Current Situation:

In a general context for the financial markets:

- Mostly silos (banks, financial intermediaries and basically any other kind of corporations) e.g. core banking IT systems use different attributes for financial products
- We are seeing players in the market that have built their own exchanges and custodian services and plan to link these to other custodians. By doing so, they are setting the infrastructure basis for future applications in the area of decentralised finance.

Tokens are immutable in the sense that they represent a right and/or legal asset that can be owned, traded, bought and sold (in fraction or in whole). Tokens are mutable in the sense that they can be transferred in a seamless way between custodial and non-custodial holders.

Tokens are also mutable in the sense that they can be enhanced or supplemented with metadata, with clear distinction between the originally created token and the supplementary ‘enriched’ data added to it. For example, a token that represents a physical item or digital asset might have photography, or supplementary data ‘wrapped’ around it. The token and the added data are treated as one entity. Lineage and trading history of tokens are transparent and available to the owner, custodial holder, and regulators to aid in KYC/AML regulations. Tokens owned or offered by one entity or institution can be (with appropriate permissions) bundled (in part or in whole) into larger pools of tokens or tradable assets to be treated like a part of an exchange traded fund, that can be purchased or sold on an open market.

Future interoperability requirements and capabilities

In reference to chapter 1, we already defined who the ecosystem partners are and who will play an important role in a world where tokenized assets are common financial products.
In this chapter, we will define in more detail how the different ecosystem partners might work together using concrete examples. We will be analysing the examples considering the following three main interoperability use cases which we believe are the most important to solve first:

- DLT to DLT: Two distributed ledgers technologies are able to communicate with each other.
- DLT to external: A distributed ledger communicates with an external entity (e.g. governmental for tax reporting) or a custody provider/issuer.
- External to DLT: External data sources (e.g. KYC, fiat / real world data enriches an asset) inputs data into the DLT.

We believe the most pressing use cases can be introduced with the examples below. Each example is accompanied with a graphic showing how the current ecosystem might be able to function in the future when the below outlined interoperability use cases have been introduced.

“Automated reporting and claim settlement”

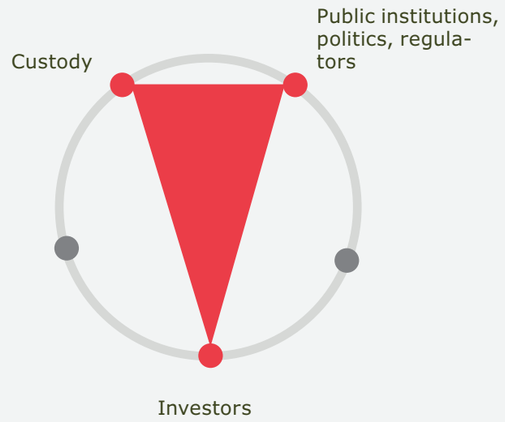
Investors have the right to self custody, or to hand their tokens to a third party custodian for safekeeping, ease of management, or portfolio consolidation. In the case that an individual keeps sole custody of their tokens and thus private keys, self-reporting can be performed through a third party offering to provide comprehensive reports on transaction dates, fiat value in local currency where the tax obligation lies at the tax measurable date in a certified format with strong references either to a blockchain or other certificate authority to support audit requirements.

In the case that an investor uses a third party custodian of their assets, the custodian either themselves or through a third party provider facilitates all reporting outputs that are needed to satisfy government taxation requirements of domiciles where the token holder has tax obligations.

Zero Knowledge Proof (ZKP) can for example greatly simplify and streamline communication to the tax offices, with custodian agreements and taxes automatically deducted from our holdings. How do they work? ZKPs permit us to obtain cryptographic proof without disclosing our full information. Imagine having to be above 21 years of age in order to have a drink in a bar: right now you can’t prove to be of adult age without disclosing your full date of birth by displaying an ID Card to the bartender. The tax declaration must contain exactly your income and/or wealth to know if you are entitled to certain benefits or reductions. With Zero Knowledge Proof it is possible to prove certain conditions without fully revealing your data, with a variety of ways and techniques.

Zero-Knowledge Proofs are an actively researched field in cryptography with numerous subtopics. By combining Decentralised Identity and Blockchain, assertions and verifiers can be employed to prove certain conditions to a third party, thus allowing for automated workflows that could save hours in compliance and paperwork. Tax Declaration and Return for crypto assets could be handled securely and privately in this manner, and not where trusted custodians are employed to verify specific assertions made by users. A particular version of Zero-Knowledge Proof, Proof of Reserve, can be used to demonstrate the availability of particular crypto assets without compromising the privacy of these assets. Furthermore, this is increasingly employed to affirm the solvency and liquidity of Exchanges, a subject of great relevance in the present day.
From the point of view of the investor, the future could look so: Investors keep their private keys to themselves or provide it to a (regulated) third party custodian. All rights stay with the investor. A specialised software tool assists the investor to consolidate all its assets. It also enables the investor to report the balances, earnings and transactions anonymously to the tax office. In theory it could even be imagined that the respective due tax payment is automatically deducted, while labelling the investor as having settled its tax payments in full. While an automation to this degree might be unrealistic in a timeframe of only 10 years, efficiency gains to some lower degree may very well be in sight.

Example: Investor, Custordy, State



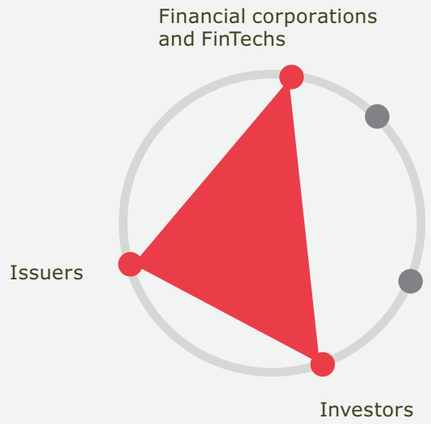
Verified proof of (digital) assets/reserve

An investor who keeps their keys at a custody provider is very interested in verifying that their assets are secure. As discussed in detail in the previous chapter on custody and safekeeping, this is still an unresolved issue due to existing systems and processes. Additionally, there is currently a lack of open systems, which is being addressed through initiatives such as Open Banking API (in Switzerland) and others worldwide.

The task of a custodian is to provide necessary assistance in documenting the fiscal documents of the held assets. Once these assets are tokenized, this documentation would also need to include a mechanism to be able to verify if the underlying asset is still existing and is therefore auditable ([9]).

Being able to introduce interoperability options like a standard API between a custody provider and the issuer would make such documentation possible, reduce costs and provide additional transparency.

Example: Individual, Custody Provider, Issuer



[9] Collateralization and Proof of reserve

Transactions rules and parametrization

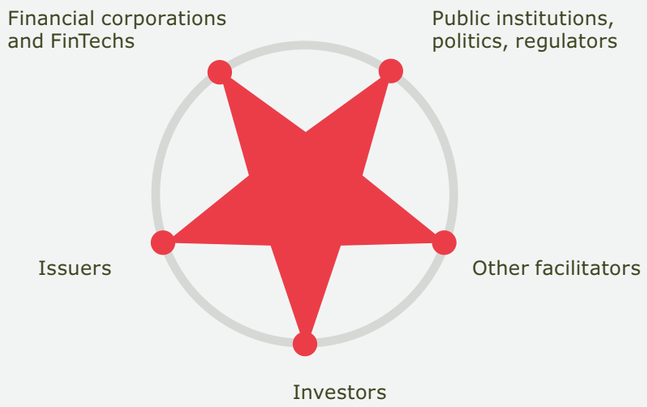
Moving an asset, for example, money or the contract of ownership for a building, from a traditional financial system to a token ecosystem requires clear regulation of the involved process. Once the asset has been moved, the traditional asset must safely be destroyed.

If the client does not yet own any token assets, a new private and public key must be created for the client following standards set by a governing body. This key pair must then either be safeguarded by the client or entrusted to a financial institution or intermediary.

Once the required key pair has been created, the new token asset can be created on the DLT chosen by the financial institution. The token content should follow certain standards to allow use of the token by other financial institutions should the client wish to move his assets to another bank.

Only the financial institution wishing to transfer the asset to a token ecosystem should be entitled to initiate such a transfer, as this institution will be reliable for the proper execution and adherence to the rules set out by the governing body. However, the transfer may only be done if the client owning the traditional asset or intermediary signs the transfer with the matching private key.

Example:
Traditional Financial System
to Token Ecosytem



Cross chain transactions incl. KYC-data reconciliation

Different partners might use different technologies. Assume a client of Bank A wants to become a client of Bank B. This process is cumbersome both for the client and the bank as the client needs to gather all documents again and the bank must verify it again: the KYC process is duplicated, creating cost and effort for both parties.

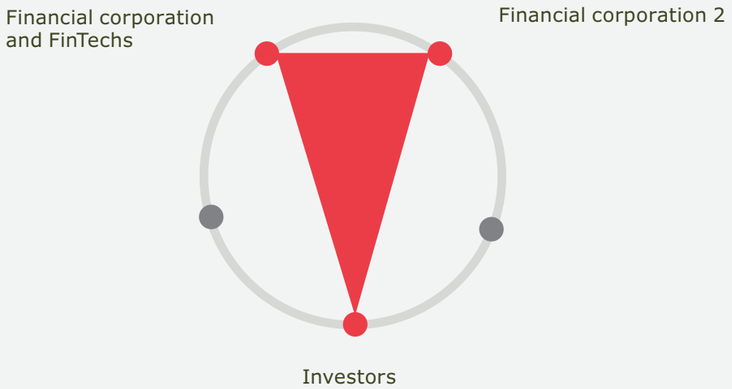
Irrespective of the DLT solution Bank A and B are using, it shall be possible to exchange special tokens which represent e.g. the result of a KYC check and therefore, make use of a cross-chain interoperable protocol ([7]). This token is issued by Bank A, as the initiator of the KYC process, and shared with Bank B on request and with the approval of the client. Bank B might require additional information from the client (i.e. the product asks for it) and amends the token with it after it ran through the additional KYC step.

The process (policies, guidelines, IT solution) used for the KYC procedures might differ from Bank A to Bank B. Meanwhile, the token exchanged on the DLT platform is product-agnostic and receives and stores information from different KYC products in a standardised format. Data flows from external to DLT, and in a limited scope also from DLT to external. A simplified process may look like this:

Step	Actor / Data flow
Perform KYC checks	*Bank A*
Store data and decisions	*Bank A*
Create token	*Bank A > DLT*
Exchange token	*Bank A > Bank B / DLT > DLT*
Extract KYC information	*DLT > Bank B*
Perform additional KYC checks	*Bank B*
Store data and decisions	*Bank B*
Enhance token with additional KYC information	*Bank B > DLT*

[7] Chainlink, Cross-Chain Interoperability Protocol

Example: 0ther technologies to token ecosystem



Exchanges among different token ecosystems

In the situation of a token ecosystem to token ecosystem transfer, interoperability capabilities must be enabled at multiple levels, covering both technical, compatibility and regulatory aspects.

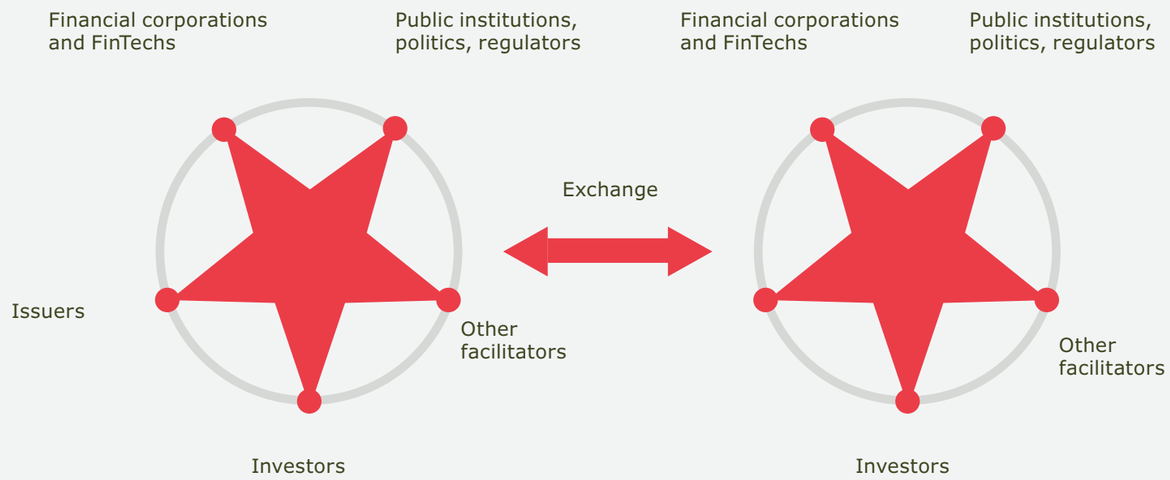
A token-to-token atomic swap is a prime example of a predominant use case in a token-ecosystem to token-ecosystem transfer.

An atomic swap can be performed for various reasons, such as moving of tokenized assets to a different store of value such as a stablecoin, to a different ecosystem in order to take advantage of the destination ecosystems properties or value-added services, or even simply an exchange to facilitate a currency swap in the case of crypto currencies.

In this process, a smart contract or other mechanism on one ecosystem communicates via an open standards-based approach to enable the transfer of a valued amount of tokens from ecosystem A, to an equally valued amount of tokens from ecosystem B. The value of the tokens can be defined by the market, the initiator of the trade, or by the sending and receiving parties.

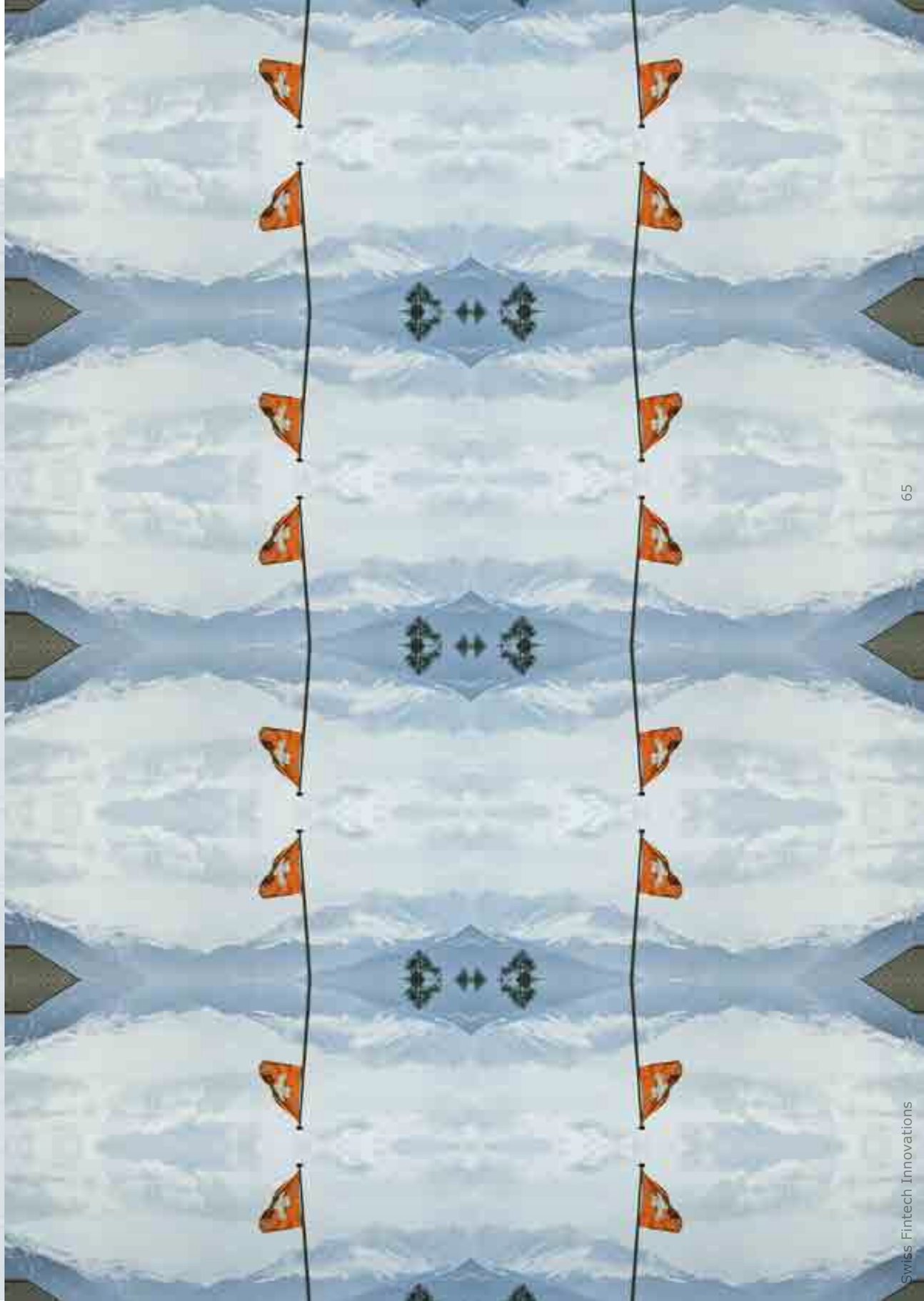
As part of the atomic swap, capabilities to support destruction of the tokens in ecosystem A must be present and executed as part of the swap process to avoid a double-spend scenario.

Example: Token Ecosystem to Token Ecosystem



Regulatory / Legal interoperability

All of the aforementioned pillars constitute our vision, but are unattainable if we cannot ensure interoperability between them. Moreover, it is essential to bear in mind that a successful adoption of tokenized assets will necessitate a variety of policy alterations, including regulatory acceptance and interoperability between different jurisdictions. This inter-jurisdictional interoperability can only be achieved through a harmonisation of existing policies, similar to those of today's stock exchanges. The policies and technologies already adopted by crypto-friendly countries can trigger policy learnings in other countries and potentially inspire similar policies to be implemented by other jurisdictions. This would, in turn, bring about a diffusion of relatively consistent policies that would enable inter-jurisdictional exchanges and interoperability.



Conclusion & Outlook

The report at hand first established a framework consisting of contextual as well as main elements of the vision of tokenized finance. This vision targets a horizon of roughly ten years and strives to maintain a balance between aspiration and pragmatism. The significance of regulatory and legal facets is recognized, but deliberately excluded from the primary elements. Future efforts shall address these associated challenges in detail.

Having scrutinised all components of the newly developed framework, this chapter will now summarise the most crucial points and illuminate certain previously discussed areas. These areas exhibit potential for advancement, which could be instrumental in realising the broader vision.

As we envision the future of a tokenized financial market, we foresee an evolution underscored by a surge in tokenized assets, used and processed by an ever-expanding group of participants. Transparency, the critical catalyst, will pave the way for unprecedented efficiency, making transactions faster, more cost-effective, and knowledge-driven. In this environment, the marketplace will become more dynamic, with assets readily convertible into other assets across different ecosystems. This eventually shall result in greater liquidity (or at least tradeability), new business models, which are difficult to foresee and eventually potential for economic growth.

To realise this vision within the next decade, we acknowledge the pivotal role of interoperability among different (eco)systems, technologies, standards and legal jurisdictions. Our commitment is to foster interoperability, breaking down barriers and expanding possibilities for engagement, thus spearheading a more connected, efficient and inclusive digital asset market, while adhering as well as supporting to develop the needed regulation.

Summary of the vision of tokenized finance

Based on the above analysis and the formulated vision for each building block of tokenized finance, SFTI recommends following actions to be considered by the enterprises, institutions, innovators and regulators of the financial services industry:

- *Interoperability between Financial Platforms and Digital Assets Ecosystems*

  The current situation in the financial market is that most financial institutions maintain their own ledger or platform, making the transfer of financial products or assets costly and time-consuming. Simultaneously the world of tokenization is very fractionalised and relies on many different ways of how to do things. The goal should be to bring the traditional world closer to the world of tokenized assets and to make these systems interoperable. They need to be able to easily communicate with each other.

- *Payment leg*

  We need a functioning payment leg for the DvP-process. Thus, a well working and regulated stablecoin and/or CBDC or "Deposit Token" is essential for the transparency and efficiency of our Swiss financial system.

- *KYC & E-ID*

  To be able to fulfil the regulatory needs the Financial Services industry needs new ways of collaboration and data management in terms of relation to personal data and identity management. These means of identification and authentication best need to be usable across different industries.

- *Secondary markets*

  We need a clear structure of different secondary markets that allow a smooth transaction process for any kind of token. The structure might differentiate between issuer types, asset types and volumes. Nevertheless a transition towards another secondary market should always be enabled if necessary. As standards might differ we need practical transition processes and APIs across systems.

- *Disintermediation awareness*

  Decentralisation plays an essential role in tokenization. However, often it is not easy for users to detect the level of disintermediation. Thus we envision the industry to develop practical tools to identify associated risks with different approaches. This could e.g. relate to custody solutions. The working group in general supports the possibility for self custody. If other solutions through third parties are being used a clear identification of the kind of custody solution would be expected. This shall also include the associated risks and could e.g. be put in action via the implementation of a labelling solution.

- *Increased automatisation*

  The end-to-end banking processes of transactions even in the digital asset space still bears a lot of room for improvement. Tokenizing more and more assets is one way to reduce unnecessary oracles and thereby API-risks. However, also the general process of linking the digital assets with directly legally binding rights and duties (e.g. corporate actions) is further developable.

- *Education*

  In the area of Digital Assets education is key for increasing the adoption of new asset classes, creating new customer segments and further developing innovative and secure financial products. SFTI is highly recommending the education of the retail customers and institutional customers in matters of custody and self-custody. While a retail customer can decide for self-custody by means of a hard or cold wallet, the institutional clients must adopt a most probably centralised custody solution.

What comes first?

Putting the vision, its ideas and proposals into a chronological order is difficult to impossible. There are various underlying chicken-and-egg situations at play, which can be challenging. Nevertheless, the working group has attempted to summarise the key underlying actions that should lead to a tokenized world of finance. These actions all relate to the elements of the previously introduced framework of tokenized finance. They also point to external factors (i.e. not necessarily DLT-related developments), such as the introduction of a widely accepted e-ID, which could break some of the causality dilemmas in the introduction of new, more efficient, transparent, inclusive and possibly more liquid markets.

In the coming years, the area of tokenized finance is likely to see significant growth and innovation. As the financial industry continues to embrace blockchain technology and decentralised finance solutions, several key priorities and focus areas are likely to emerge:

Set necessary regulation and provide education

Foster interoperability

Guarantee safekeeping

Reduce hurdles to issue, trade and pay

Interlink with contextual developments

Develop additional applications

- *Regulation and Compliance:* As tokenized finance becomes more mainstream, regulatory frameworks will play a crucial role in shaping its development. Establishing clear and favourable regulations in Switzerland that address issues like investor protection, anti-money laundering (AML), and know-your-customer (KYC) procedures will be essential to foster trust and adoption.

- *Guarantee safekeeping – Security and Auditing:* Security remains a top concern in the digital assets space. Enhancing the security of smart contracts, conducting regular audits for them, and addressing vulnerabilities will be critical to protect users' assets, maintain investor confidence and reduce the risks of security breaches.

- *Foster Interoperability:* Improving interoperability between different blockchain networks and token standards will enhance the efficiency and usability of tokenized finance. Cross-chain solutions will enable seamless movement of assets between different platforms, creating a more connected and accessible financial ecosystem which is globally intertwined.

- *Reduce hurdles to issue, trade and pay & Develop new applications:*

- *Scalability:* As tokenized finance gains popularity, scalability will be crucial to handle increasing transaction volumes. Layer 2 solutions and advancements in blockchain consensus algorithms will be important to address the existing scalability challenges.

- *User Experience:* Improving the existing user experience and making tokenized finance more accessible through easy to use products and applications is essential for wider adoption. Streamlining the onboarding process, simplifying wallet management, integrating TradFi with DeFi and offering intuitive interfaces will attract more users to the ecosystem.

SFTI underlines with this study also the importance of education in the area of digital assets. We strongly believe that education is a pivotal part in increasing the adoption of tokenized assets. This should cover all aspects and layers of it: from user experience, user benefits to infrastructure, underlying technology and its implementation in order to create the expected trust in a new generation of products and services.

Education

Digital assets are here to stay and Tokenized Finance is expanding. The underlying blockchain technology is unique and we are convinced that technical specifics have a high impact on potential use cases.

So how does their underlying technology work and how can their potential be harnessed by individual stakeholders? Besides the framework conditions discussed in this paper (e.g. digital identity, security), stakeholders of all kinds need a basic understanding and basic knowledge of the technology in order to be able to leverage the advantages of Tokenized Finance as a whole or to mitigate risks. There is a certain level of expertise across multiple domains necessary to identify the use cases along the value chain and formulate a strategy that can be successful.

So how can you develop this expertise for tokenized finance and its underlying technology? One way to kickstart this development is by participating in training. This allows for first contact points with the underlying technology and allows for an easier entry for more complex topics. Through additional hands-on experience and proof-of-concepts, a solid knowledge can be built up.

However, training is not only a way to build knowledge, it also offers further opportunities to connect with experts, exchange knowledge and opinions. They can also serve as a way to sensitise decision makers about potential fraudulent or unethical activities.

Overall, we see education as a key element to support the development of tokenized finance and leverage its benefits in our economy.

Annex / Glossary / References

Asset Leg: represents the exchange of the security itself. If you are buying stocks, the asset leg involves the transfer of the stock from the seller's account to the buyer's account.

Asset Token: An asset token represents a right of ownership over an asset which derives its value from something that does not exist on the blockchain, but instead is a representation of ownership of a physical asset.

AML: Anti money laundering (AML) refers to the regulations, laws and procedures that aim to uncover the laundering of money obtained through illegal activities, in this case specifically through cryptocurrencies.

APY: annual percentage yield is the real rate of return earned on an investment, taking into account the effect of compounding interest.

Atomic swaps: atomic swaps is a concept whereby assets of one ecosystem are 'swapped' for an equally valued amount of assets on another distinct ecosystem, with the original asset being eliminated or rendered permanently unusable to avoid false inflation.

Bitcoin: The first cryptocurrency, created in 2009 by the pseudonymous Satoshi Nakamoto. It is a distributed and peer-to-peer cash system using blockchain technology.

Blockchain: A technology to transfer and store information in a distributed and trustless way in a network of participants.

Bridges: Allows for transfer of data or tokens between two different blockchain protocols.

Burned: Permanently removed tokens from circulation purposely.

Cash Leg: commonly used in financial transactions, particularly in the context of trading and settlement involving multiple currencies or assets. It refers to one side of a transaction, where cash or a cash-equivalent is involved. Cash leg represents the exchange of cash for the purchase or sale of a security (e.g. stocks, bonds). If you are buying stocks, the cash leg involves the payment of cash to acquire the shares.

CBDC: stands for Central Bank Digital Currency which is the digital form of a country's fiat currency. A nation's monetary authority and central bank issues and regulates a CBDC. Their value is linked to the issuing country's official currency.

CEX (Centralised Exchange): Centralised exchange operated by a company, e.g. SIX.

Consensus: The process used by a group of peers, or nodes, on a blockchain network to agree on the validity of transactions / common state submitted to the network. Dominant consensus mechanisms are Proof of Work (PoW) and Proof of Stake (POS).

Crypto asset: A digital/virtual asset that uses cryptography to facilitate its operation (either as a currency or application).

CSD: central securities depositories.

Custody: The safekeeping of digital asset private keys.

DeFi: Short for Decentralised Finance. Any blockchain based financial service.

Digital asset: any type of asset in digital format, that can be stored, traded, used digitally and that has an established ownership (i.e. tokenized shares, CBDCs, stablecoins, images, documents, rights, utilities, real estate, tokenized funds). The term is often used to describe assets baked on blockchain technology.

Digital currencies: There are many types of digital currencies. For example the money from the checking bank account or from the savings bank account is digital currency. For the purpose of this white paper we will define digital currencies as digital forms of currency that are using blockchain technologies.

DvP: Delivery versus Payment. The DvP process ensures that the delivery of securities occurs simultaneously with the payment for those securities, reducing counterparty risk and ensuring a smooth and secure settlement.

Ether (ETH): The second-largest cryptocurrency, used by the Ethereum blockchain.

Ethereum: An open-source platform based on the Ethereum Blockchain launched in 2015. It offers smart contracts, making it possible to offer a flexible range of use cases besides the transfer of value.

Fiat currency: Government-issued currency. For example, CHF, US Dollars (USD), Euros (EUR).

Floating cryptocurrencies: currencies for which 1. their value is determined by the consensus mechanism and the algorithm that is set up for the particular blockchain and 2. the value of that currency is determined by supply and demand dynamics (i.e. Bitcoin, Ethereum).

FINMA: Swiss Financial Market Supervisory Authority (Eidgenössische Finanzmarktaufsicht).

Gas: Computational effort required to complete a transaction on ETH, often referred to as transaction fees.

Governance Token: Token that can be used to vote on decisions that influence an ecosystem.

Hash: A programmatic function that takes an input, and then outputs an alphanumeric string known as the “hash value” or “digital fingerprint.” Each block in the blockchain contains the hash value that validated the transaction before it followed by its own hash value.

Hash Rate: Measure of performance revealing how many hashes per second a computer can do. Each hash is an attempt to find a new block.

Hard Cap: Maximum supply of a digital asset mostly hard-coded in the protocol.

Helvetia Project: Project of Swiss National Bank testing the settlement of tokenized assets in CBDCs; https://www.bis.org/about/bisih/topics/cbdc/helvetia.htm

ICO: An Initial Coin Offering (ICO) occurs when a new cryptocurrency sells advanced tokens in exchange for upfront capital (“IPO for cryptocurrencies”).

Interoperability: Technologies allowing different blockchains to interact with each other directly or via intermediaries.

KYC: Know Your Customer. A standard procedure to identify the client’s identity, risk preference and financial situation.

Layer 2: Layer 2 is a set of upcoming scaling solutions for Ethereum and other blockchains.

Liquidity Pool: A liquidity pool is a crowdsources pool of cryptocurrencies or tokens locked in a smart contract, which is used to facilitate trades between the assets e.g. on a decentralized exchange (DEX).

Multisig wallet / transaction: A crypto-asset wallet that requires multiple keys to access. Typically, a specified number of individuals are required to approve or “sign” a transaction before they are able to access the wallet. This is different from most wallets which only require one signature to approve a transaction. MultiSig can be enforced by a program (Ethereum) or more natively (e.g. Bitcoin).

Native tokens: are a blockchain’s digital currency. Every independent blockchain has its own native crypto currency that is used to reward miners and validators for adding blocks to the blockchain. Hence, native tokens are used as a payment method, including for transaction fees. Examples of native tokens include Ether (ETH), bitcoin (BTC) and solana (SOL).

Non-native tokens: are derivatives of a blockchain built to rely on the native token. Non-native tokens are made for specific purposes and come in the form of governance tokens, wrapped tokens, and stablecoins, among others.

NFT: Non-fungible token, a type of digital asset token used to represent a unique (non-fungible) item. Owning this token proves ownership over the associated item, normally art, music and the like.

Payment Leg: The payment leg refers to the part of the transaction where the actual payment takes place in a specific currency . It involves the movement of funds from one party to another to settle the financial obligation. The payment leg is typically associated with the currency used for payment and represents the transfer of value from the payer to the payee. For example, in a foreign exchange transaction, the payment leg would involve the transfer of the agreed-upon amount of one currency to the other party.

P2P lending: Decentralised interaction between parties in a distributed network. Use case: Two individuals lending each other money, in exchange for interest.

Peg: Specific price for the exchange rate between two assets, mostly used for “pegged” stablecoins.

Private Key: A private key is an alphanumeric string of data that, in MetaMask, corresponds to a single specific account in a wallet. Private keys can be thought of as a password that enables an individual to access their crypto account. Never reveal your private key to anyone, as whoever controls the private key controls the funds associated with the corresponding address. If you lose your private key, then you lose access to that account.

Proof of Authority: A consensus mechanism used in private blockchains, granting a single private key the authority to generate blocks or validate transactions.

Proof of Stake (POS): A consensus mechanism in which an individual or “validator” validates transactions or blocks. Validators “stake” their cryptocurrency, such as ETH, on whichever transactions they choose to validate. If the individual validates a block (group of transactions) correctly then the individual receives a reward. Typically, if a validator verifies an incorrect transaction, then they lose the cryptocurrency that they staked. POS requires a negligible amount of computing power and thus energy compared to Proof of Work consensus.

Proof of Work (PoW): A consensus mechanism in which each block is ‘mined’ by a group of individuals or nodes on the network. Hashing a block, which in itself is an easy computational process, under PoW each miner is required to solve a difficult variable. The process of hashing each block becomes a competition. For each hashed block, the overall process of hashing will take a certain amount of time and computational effort. Thus, a hashed block is considered Proof of Work, and the miner that successfully hashes the block first receives a reward, in the form of cryptocurrency. PoW is significantly more energy-intensive than other consensus mechanisms, such as Proof of Stake.

Protocol: A set of rules that dictate how data is exchanged and transmitted. This pertains to cryptocurrency in blockchain when referring to the formal rules that outline how these actions are performed across a specific network.

Public key: The public key is derived from your private key, but one cannot derive a private key from a public key. The public key, therefore, is obtained and used by anyone to encrypt messages before they are sent to a known recipient with a matching private key for decryption. Often, the blockchain address is another representation of the public key.

Seed phrase: The seed phrase, mnemonic, or Secret Recovery Phrase refers to a set of ordered words which correspond to determined values. These values never change, and therefore the same string of words in the same order will always produce the same number – this is the underlying functionality that allows seed phrases to back up wallets. In fact, the phrase can be used to restore your private keys and provides access to all related funds.

Slashing: known as staking punishment or slashing penalty, is a mechanism used in certain blockchain networks, particularly those that use Proof-of-Stake (POS) or Delegated Proof-of-Stake (DPOS) consensus algorithms. It is designed to deter malicious behaviour and ensure the security and reliability of the network. Crypto slashing occurs when a validator or block producer is found to have violated the rules, jeopardising the network's integrity. Such violations can include double-signing (confirming two different blocks at the same height), censorship of transactions, or other forms of malicious behaviour. When a validator is caught engaging in such activities, a slashing mechanism is triggered, resulting in the partial or complete confiscation of the staked tokens as a penalty. The confiscated tokens are "slashed" from the validator's stake, and in some cases, they may also face temporary or permanent exclusion from the network.

Smart contracts: Smart contracts are programs whose terms are recorded in computer code. While they often contain agreements or sets of actions between parties that emulate a traditional legal contract, they are not, in and of themselves, legal documents (i.e. contracts). Smart contracts are automated actions that can be coded and executed once a set of conditions is met and are the dominant form of programming on the Ethereum Virtual Machine.

Stablecoins: Where you take fiat money – regular currencies that we use today – and issue a token against it. As you can imagine, the value of that stablecoin in most cases directly follows the underlying currency that was collected before issuing the currency

Staking: Crypto staking is pledging a cryptocurrency toward helping validate transactions on the blockchain.

STO: Security Token Offerings (STO). Comparable to IPOs, representing a share of an asset (e.g. a company) in the form of asset tokens. Compared to ICOs, STOs are more heavily regulated.

Tokenization: The process of turning a physical object into a virtual one in the form of a token using blockchain technology.

Token swaps: are important to help facilitate liquidity. Tokens can be swapped to an asset such as a stablecoin to either avoid market unrest and provide stability for a period of time.

Trading: Trading refers to the act of finding a counterparty and agreeing with that counterparty on a price for a certain number of units of assets. A central trading venue matches ask and bid orders and therefore demand and supply for a certain asset. The act of trading is clearly separated from the act of transferring the asset and obtaining legal finality on the transfer (i.e. settlement). While for spot markets, per definition, settlement typically takes place shortly after the trade has been concluded, in derivatives markets settlement may be well in the future.

Wallet: A cryptographic key pair and often referred to as a designated storage location for digital assets which has a public address for sending and receiving funds, hence the word wallet.

Yield Farming: Earning interest by investing on decentralized financial markets, mostly when an investor earns interest by lending digital assets to others or locking up the crypto in a liquidity pool.

Disclaimer

The vision formulated in this paper represents the view of the Swiss Fintech Innovations association and is not the specific views of the financial institution representatives, who contributed to this paper.

Authors

Please note that this report has been written by the below authors as individuals and subject matter experts.

SFTI Member Institutes

First Name	Surname	Function	Company
Andra	Maute	Enterprise Architect	Zurich Insurance Switzerland
Gianin	Basler		
Raphael	Bianchi	Senior Partner	Synpulse Switzerland
Dominique	Brodbeck	Senior Project Manager	Hypothekarbank Lenzburg AG
Nils	Bulling	Head Product Domain Digital Assets	Avaloq
Francesco	De Collibus	IT Architect	AXA Switzerland
Pascal	Egloff	Lecturer and Head Competence Center for Banking & Finance	Eastern Switzerland University of Applied Sciences
Janis	Heibel	Head of Digital Assets	Synpulse Schweiz AG
Stefan	Jeker	Head Innovation Management	Raiffeisen Gruppe
Carl	Jensfeld	VP	Mastercard
Holly	Jones	VP, Blockchain & Digital Currencies	Mastercard
Marco	Kessler	Head of R&D	SDX
Tatiana	Müller	Director Account Management	Mastercard
Stefan	Neumann	Director, Compliance	Credit Suisse (Schweiz) AG
Peter	Durrer	Emerging Payment Expert	Mastercard
Magdalena	Platter	Key Account Executive	Google Cloud Switzerland
Guilhem	Sirven	Innovation Manager	Banque Cantonale Vaudoise
Nicolas	Potterat	Strategic project manager	Banque Cantonale Vaudoise
Maria	Sommerhalder	Managing Consultant	Eraneos
Sandro	Sutter	Projektmanager	AdNovum
Mia	Van	EMEA Lead, Blockchain and Digital Assets	Mastercard
Andrew	Vieyra	Principle Architect	Google Cloud Switzerland
Kornel	Wassmer	Head Market Unit Banking	AdNovum

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Author:
SFTI Working Group Digital Assets
office@swissfintechinnovations.ch
+41 79 953 81 33

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Rämistrasse 5
P.O. Box, 8024 Zurich
Switzerland

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Alltag Agentur
St. Gallen
Switzerland